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"……IF REAL WORLD FOOD CRISIS WERE TO OCCUR, IT WOULD BE MAIZE, NOT RICE OR WHEAT. THAT WOULD PLAY THE KEY ROLE IN OVERCOMING IT AND PREVENTING STARVATION……"

DR NORMAN BORLAUG
NOBEL LAUREATE

Bangladesh

PL-480, TITLE III

MAIZE STUDY

SEPTEMBER 1987

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AST	=	Agriculture Sector Team
BADC	=	Bangladesh Agricultural Development Corporation
BARC	=	Bangladesh Agricultural Research Council
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
BCSIR	=	Bangladesh Council of Scientific and Industrial Research
CMP	=	Concentrated Maize Protein
CIMMYT	=	International Maize and Wheat Improvement Center
CARE	=	Cooperative for American Relief Everywhere
CIDA	=	Canadian International Development Agency
CSM	=	Corn Soybean Milk (powdered)
DU	=	Dhaka University
DAE	=	Directorate of Agricultural Extension
FAO	=	Food and Agriculture Organisation
FPMV	=	Food Planning and Monitoring Unit
FFWP	=	Food for Work Program
GOB	=	Government of Bangladesh
INFS	=	Institute of Nutrition and Food Science
MR	=	Modified Rationing
MCC	=	Mennonite Central Committee
MT	=	Million Tons (Metric)
MLT	=	Multilocation Test
NSB	=	National Seed Board

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OMS	=	Open Market Sale
OFR	=	On-Farm Research
PFDS	=	Public Food Distribution System
PL-480	=	Public Law 480
QPM	=	Quality Protein Maize
SR	=	Statutory Rationing
USAID	=	United States Agency for International Development
VGFP	=	Vulnerable Group Feeding Program
WFP	=	World Food Program
IBRD	=	International Bank for Reconstruction and Development.

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Glossory of Some Local Terms

KHAI = Local popcorn

KHICHURI = Gruel, often containing pulses as well

PITHA = Local cake

SHATU = Ground parched grain

ROOTI = Thin bread (unleavened)

CHAKKI = Stone grinder (manual/mechanical)

DHEKI = Manual pounding device

ANSAR = An armed security police force

KHARIF-1 = Early monsoon crop season (March-June)

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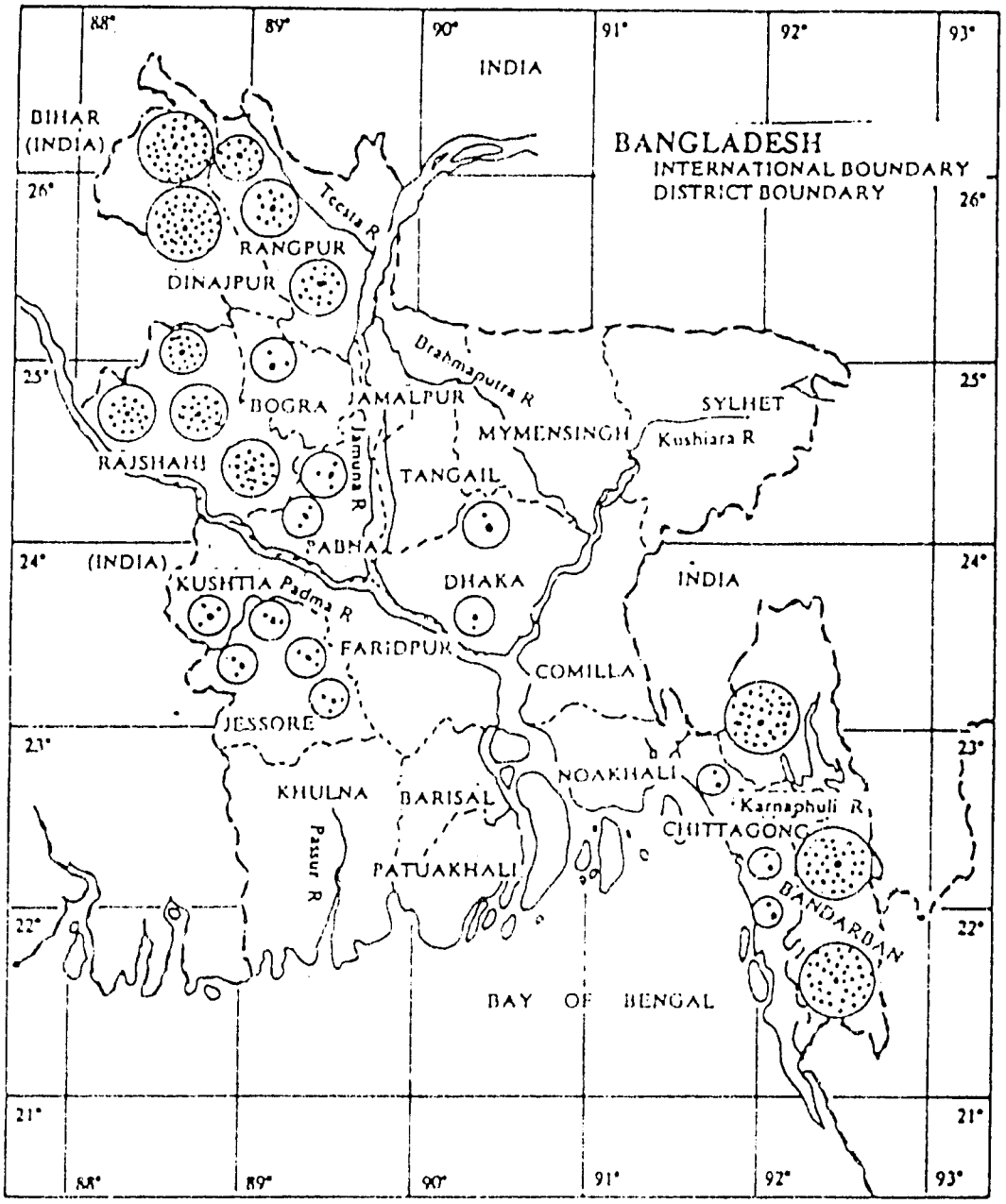

Map of Bangladesh showing areas of maize production
Source: BBS
• Location within district
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Acknowledgement

The authors are indebted to the various officials of the Government of Bangladesh, US-AID personnel, private industrialists, and respresentatives of some non-government organizations and relief agencies who shared their views with us and provided us with valuble informtion, reports and documents. Without their valuable contribution the study could not have been completed. Authors are especially grateful to Mr. Alan Hurdus, Deputy Director, Food and Agriculture, US-AID, Dr. S.M. Elias, Head of the Division of Agricultural Economics, BARI, Mr. S. Ahsan, Managing Director, Phoenix Poultry Ltd., and President, Bangladesh Poultry Development Association, for enriching our information base. The authors are grateful to Mr. Charles Hash, Director, Food and Agriculture Division, US-AID, Dhaka and Mr. Lowell E. Lynch, Food for Peace Officer, Food and Agriculture Division, US-AID, Dhaka for their editorial comments and suggestions. The study, however, is solely the responsibility of the authors. In the short time available, and due to severe floods in most of the potential areas of maize cultivation, the authors could not collect first hand information on some production and marketing aspects from key north-western areas. It is therefore possible that some points were missed, whereby a complete picture of the potential of maize industry could not be obtained. If so, the authors apologize for the lapses and hope that the same would not detract from their sincere desire to help establish the fact that maize could make an important contribution to the Bangladesh food security and employment generation in the coming decades. This paper should not be considered as a definitive study on the subject. A number of issues, to be studied further in depth, have been identified. However, the strategy discussed could form the basis for initiating a phased program on maize utilization and production in Bangladesh.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

- To help attain food self sufficiency and rapid agricultural development in Bangladesh, maize can be used as a reliable and versatile grain crop with potential to produce human food, livestock feed and fodder as well as industrial raw material. It has the potential to emerge as the third important-most crop even when occupying only 1.5 - 2.0 percent of the total cropped land. Should the crop occupy large areas in the marginal farmers' fields it can become a major source of fuel and fodder. The versatility of maize as a field crop and its flexibility to fit into the varied farming systems put this crop above rice and wheat. Introduction of maize, at least in the beginning, will not significantly reduce areas under other major crops.

- Maize being a relatively new crop for Bangladesh, assured supply and sustainable demand will need to be created through various mechanisms; the most effective one being the import of maize grain for human and livestock consumption under the PL-480 Title III program. A firm government policy to utilize and produce maize in Bangladesh is called for.

- Future expansion of maize production should be treated as a brand new enterprise, unconnected with the traditional cultivation of maize for green cobs in a few isolated pockets around urban areas. Its scope as well as limitations posed by production, post-harvest and marketing challenges are going to be distinctly unique. These specific issues have not been experienced by Bangladeshi farmers in other major crops.

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- A successful maize production and utilization program calls for a coordinated approach which would simultaneously stimulate consumption, enhance production and lay down policies for pricing, guidelines for research and extension and a strategy for long range development. In this report an attempt has been made to discuss issues related to utilization and production of maize with special reference to its import under Title III program in a manner that the sale proceeds of the first two years of imported grain are ploughed back into research, extension, production and promotion of the crop.

Utilization

- A modest phased program, starting with the import of 10,000 tons in 1988 and increasing upto 50,000 tons in 1999, has been proposed. These recommendations could be termed conservative considering the demand that was generated through promotion of wheat in the mid seventies. However, it is better to start with attainable goals rather than desirable ones.

- As human food, the existing assured market for maize is limited to the green cobs, predominantly in the urban areas. Despite voluminous reports, generated on green cobs, this form of demand has been ignored.

- From our investigation it was revealed that no less than one million population, composed of Bihari and tribal people, are already accustomed to eating maize as flour and grits, respectively. Therefore, based on this existing demand, that to be generated by incorporating maize as a component in the PFDS, and demand from poultry farmers, 10,000 tons of annual import seems to be reasonable.

- Like wheat, maize need not be thrust upon people since it can be introduced in several culinary forms. To target it on the population at large, a sound and sustained educational campaign would need to be launched to dispel the false notion that maize is an inferior food. A distribution mechanism for maize suggested in this report is patterned along the PFDS operational procedures. It involves the distribution of 7 thousand tons of maize for human consumption, in 1988, through open market sale, rationing, FFWP, VGFP and gratuitous relief. About 40 percent of the grain will be self targeted through FFWP. Maize would be distributed in the same manner as wheat through the Ministry of Food.

- Initially maize can be successfully introduced in the FFWP and in the rationing system as a 25 percent extender of wheat flour. Ultimately the proportion of maize may be increased in the mix when demand increases.

- Nutritionally, maize provides higher energy per unit weight compared to wheat and rice. Yellow maize is a rich source of vitamin A and maize oil has high nutritional qualities. A sound home science research and extension program would need to be established in the country to popularize the nutritional merits of maize.

- It is recommended that an illustrated booklet on maize be published emphasizing its nutritional merits in comparison to other cereals. This publication could be directed towards extension workers and the public at large. Other means of mass media may also be used for promotion.

- In recent years, demand for maize grain for poultry and livestock production has considerably increased. An estimated 10,000 tons of maize are required annually to support the poultry farming industry in the private as well as public sector. Poultry, and dairy farmers prefer maize over wheat and rice since it provides more energy per unit of weight and also contain significantly large quantity of carotene, a precursor of vitamin A. Poultry farmers require flint (harder) structured grain, which has higher keeping quality and energy per unit weight. It is recommended that 3000 tons of PL-480 maize be sold to poultry farmers in 1988.

- Contribution of maize as fodder for draft and milch cattle is an important justification for its adoption in the farming systems of Bangladesh in view of the very precarious condition of the bovine nutrition.

- Having established that there is a firm, though limited, demand and nutritional basis for the local production and import of maize into Bangladesh, it should be reiterated that a strong promotional campaign would need to be launched if the projected targets suggested in this report are to be attained. Also, systematic socio-economic studies would need to be conducted on the cost-benefit analysis of production and on the storage at the farmers' level.

- Due to the absence of any reliable data on elasticity of demand and consumer preference of maize, it is recommended that specific studies be conducted to examine the marketing and consumption aspects of maize with special emphasis on pricing, elasticity of demand and consumer

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preference. In the world market the price of milled rice, wheat and maize, till recently, had been in the ratio of 3:2:1. The traditional pattern of prices in Saidpur (the area where we investigated and where maize is marketed) was 100:80:75 for milled rice, wheat flour and maize meal, respectively. For lack of sufficient data, we are unable to recommend the definite farmgate and consumer (including ration) prices for maize. However, it is clear that the same has to be 10-15 percent lower than wheat, both at the farmgate and at the consumer levels. Furthermore, we recommend in-depth studies on pricing and related issues at the various levels of transaction.

- A number of reports on the industrial uses of maize in Bangladesh are available. Of particular interest is the requirement of some 8-10 thousand tons of industrial starch, annually for textile, jute and other industries. This is equal to some 15 thousand tons of maize grains. More than half of the starch is imported from outside by indentors who have a strong lobby interested in the imports. The remaining portion is met through indigenous production of starch from tuber crops, manufactured by a single plant in the private sector. Based on our investigations, we are convinced that the immediate prospects for the manufacture of starch from maize are limited. No projections have therefore been made for this end-use in the foreseeable future. Similarly, limited demand of maize-based raw materials for other minor industries has been ignored in making the projections.

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- Some reports and feasibility studies have recommended large scale cultivation of maize in Bangladesh for the exclusive purpose of exporting it to some importers in the Asian region. The logic given is lower handling and freight costs from Bangladesh, leading to a favourable price. However, our analyses led us to conclude that Bangladesh can not compete in the world maize market for the following reasons: (a) higher production costs due to lower yields and returns, (b) highly stringent quality standards which Bangladesh would not be able to meet under the present circumstances, (c) lack of established quality standards in the country, (d) uncertainties in production to meet the commitments and (e) non-existing infrastructure to handle grain for export.

Production

- Maize has the potential of producing considerbly more food of higher energy value per unit area and time than either rice or wheat at equal production costs. Its yield has been reported to be twice that of wheat and thrice that of Aus rice, resulting in a better cost-benefit ratio. Yield upto 14 tons per hectare has been obtained under experimental conditions and upto 8 tons in the farmers' fields.

- Maize can grow under a wide range of agro-edaphic conditions. Being photo-insensitive it can fit into a number of cropping patterns. The crop has incredible flexibility, with a low risk for total crop loss.

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- Most studies conclude that maize can be a good substitute for Aus rice crop which occupies some 7.75 million acres of crop land, has a low yielding capacity and has shown a growth rate of - 1.73 percent annually in the past five years. With comparable inputs, maize can produce thrice as much bio-mass and grain yield per unit area. The crop can also be grown easily under rainfed conditions in the flood-prone areas in the winter season and has high yielding potential under the irrigated conditions. Based on these positive attributes of maize crop, large potential areas for maize production, upto 5.5 million hectares, have been projected. In this study a very modest rate of expansion from 1,500 hectares in 1988 to about 20,000 hectares in 1999 has been suggested. These projections are made as definite attainability rather than desirability.

- Even though very limited investment has been made on maize research in Bangladesh, the results obtained have laid a good foundation in the fields of agronomy, cropping systems, entomology, pathology and on-farm testing. A number of successful production practices have already been developed. To establish a sound maize improvement program in the country, more systematic research would need to be conducted to determine how, when, where and how much maize crop can fit in the cropping patterns in different parts of the country. CIMMYT scientists may be requested to prepare a detailed research plan involving all the various aspects of breeding, agronomy, socio-economics, farming systems, plant protection and post-harvest technology. The tentative plan presented in this report on maize improvement includes allocation on maize research for five years.

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- Bangladesh requires specific 'synthetic' flint type of varieties of maize which can be produced and maintained for several generations by local farmers without significant losses in their productivity potential.

- It will be some years before Bangladesh produces tonnage of commercial maize seeds to meet the local demand. It is therefore recommended that quality seed be imported on a regular basis till that time as local seed industry is able to satisfy the requirement. Though BADC has capability to produce and market the maize seed, it is recommended that the same be produced in the private sector. Our investigation revealed that the Bangladesh Poultry Development Association would be willing to support such an enterprise. However, it may be emphasized that BARI will have to work out a functional relationship with the BADC, and contract-growers, since they are most likely to be the producers of the foundation and commercial seed, respectively. It should be reiterated that without an effective seed production and distribution program an ambitious maize project can not succeed.

- Several gaps exist in the maize production technology, the most notable being the lack of appropriate technology for shelling, drying and storage. Appropriate research and development on these aspects are essential.

- Visible gaps have been noticed in the knowledge on socio-economic aspects of maize production. Though the available data suggest that even at 30 percent lower price than Aus rice and wheat, maize can still be a profitable crop, more in-depth research is called for since the data available are based on limited demand for green cobs and poultry feed only.

- Establishment of a sound extension program which would bring packaged maize production technology to the door-steps of farmers is critically important. Such a program should be integrally coordinated with research and should have on-farm testing as an in-built mechanism. All possible means of promotion should be used to popularize the production of maize under farming conditions in different agro-ecological regions of the country. It is recommended that several sites be selected on the basis of past experience to concentrate upon region-specific research on maize. The places to be included for such work have been identified.

- To achieve quick and effective results, it is necessary to have several levels of training in the research and extension programs of maize. The same will include 246 months of overseas training of research scientists and in-country training of extension workers and farmers. It is essential to instill quality consciousness regarding production and handling of this new crop in the farmers' minds right from the beginning of the program.

- To promote sustained growth of maize production in the country, a sound service and input program for farmers would need to be established. In the proposed National Maize Production Program, provisions have been made for modest investment on credit and inputs in the pilot production areas.

- The proposed project on maize production and utilization identifies eighteen areas for investment. The plan is presented only to indicate the major areas of concern and is subject to modification and improvements through further evaluation and analysis.

- The importance of a coordinated and simultaneous thrust is recognized. Therefore it has been recommended that an inter-Ministerial co-ordinating body for policy formulation, execution and review be formed. A budget of 3.4 million dollars over a five year period is considered to be adequate to take care of most of the requirements of this program. This amount roughly equals the sale proceeds of the proposed 20,000 tons of maize recommended to be imported in the first two years under the PL-480 Title III program. A price of Tk. 200 per mound ($170/Ton) has been used to compute this figure. It may be mentioned that the quoted f.o.b. price for US maize was $80 per ton in August, 1987.

- Non-government voluntary organizations, including BRAC, CARE, Proshika, MCC, and Helen Keller Foundation may be involved in the promotional campaign of maize.

- It is recommended that the AID office in Dhaka should appoint a local officer to work as a liaison person for the proposed national maize production and consumption program. He would assist the co-ordinator of the program in achieving the project objectives.

1. INTRODUCTION

1. INTRODUCTION

Maize (*Zea mays* L) is one of the oldest crops in the world. It is the highest yielding grain crop having multiple uses. The average yield of maize in 1981 in the world was 3.4 tons per hectare as compared to 1.9 and 2.9 tons for wheat and rice (paddy), respectively (FAO, 1982). Higher yields of maize over other cereals is due to its high response to better crop management, originating from its superior physiological efficiency (Islam and Kaul, 1986). Maize is one of the most important food grains in the world. At the same time it is an important source of feed and fodder.

Potential of maize to fill the food gap in Bangladesh has been realized and documented (BARC, 1982; Mohammad, 1985; Islam and Kaul, 1986; Hurdus, 1986; World Bank, 1985; Kennerberg, 1983).

As a part of the food-consumption planning component of the Title-III agreement, signed between the Government of the United States of America and the Government of the People's Republic of Bangladesh under Public Law-480 (PL-480) in April 1987, it has been agreed that a campaign will be mounted to introduce a new self-targeting grain, maize, into the food system. The campaign will be directed by the Food Planning and Monitoring Unit (FPMU) as an activity under the new food policy planning and experimental activities project to be sponsored by the new Title III program. The agreement mentions that the purpose of applied research into the use of maize is to develop and test low-cost nutritious, consumer-acceptable, and self targeting products such as maize flour and mixed

maize-wheat flour, which might be used in free distribution or fair-price sales programs for the needy. A second purpose is to develop and test maize products for the commercial retail market.

It was agreed that as a first step in the implementation, a plan of action outlining an illustrative sequence of actions will be prepared. Amongst other things, the plan will include development of maize food products in the laboratory, taste tests, trials in the various institutions and trial distribution through selected Public Food Distribution System (PFDS) channels. The self-targeting products and classes of recepients are to be identified. The time-table to be prepared would include designing research work in the first two years with provision for large scale testing in the third year. The PFMU is to take lead in most of the activities and sub-contract the work to local research institutes. It was agreed to hire the services of a consultant to prepare the above mentioned outline.

The scope of work of the consultancy is two fold. First, to make recommendations on the introduction of maize in the PL-480-Title III food aid to Bangladesh; prepare an action plan. Second, using the current state of the progress and by determining the prospects of the maize as a staple food crop, make recommendations on the feasibility of cultivating the same in the country. Appropriate recommendations and projections are presented.

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1.1. Foodgrain Situation in Bangladesh

Rice and wheat are the major foodgrains produced in Bangladesh. Very small quantities of some minor cereals such as barley, sorghum and maize are produced in some areas. Rice is the staple food. However, in recent years the consumption of wheat has increased considerably. Nevertheless, in comparison to rice, it still constitutes a small proportion of the total foodgrains consumed. Rice and wheat together take up about 99.8 percent of the total foodgrain production and consumption.

During the sixties foodgrain production in Bangladesh was sluggish and lagged far behind the population growth (Hossain, 1980). Since mid-70s, however, the foodgrain production started showing signs of improvement and picked up a steady pace. Table 1.1. shows that the production of rice and wheat increased from 12.0 million tons in 1973-74 to 16.1 million tons in 1985-86. The rate of growth in foodgrain production during this period was 2.9 percent compared to the population growth rate of 2.6 percent. This became possible largely due to the expansion of acreage under wheat and Boro paddy, introduction of HYV seeds, fertilizer and irrigation.

In recent years, i.e. between 1980-81 and 1985-86, the growth in wheat and Boro paddy seems to have tapered off reducing the overall foodgrain production growth rate to 1.9 percent as against a population growth rate of 2.6 percent per annum. Table 1.1 compares the growth rate of different periods.

Table 1.1. Production of Foodgrains in Bangladesh, 1961-86 ('000' tons)

FY\Grns	Class of Rice			All Rice	Wheat	All Grains	Total Population (Millions)	Per capita grain prod. (In Kg)
	Aus	Aman	Boro					
1961	2,537	6,680	455	9,672	33	9,704	56.2	172.7
1962	2,365	6,759	493	9,617	40	9,657	-	-
1963	2,237	6,143	490	8,870	45	8,915	-	-
1964	2,700	7,407	517	10,624	35	10,659	-	-
1965	2,541	7,379	580	10,500	35	10,535	-	-
1966	2,965	6,908	628	10,501	36	10,537	-	-
1967	2,717	6,014	844	9,575	59	9,634	-	-
1968	3,110	6,921	1,132	11,172	59	11,231	-	-
1969	2,726	6,980	1,638	11,344	94	11,438	-	-
1970	3,011	7,062	1,934	12,006	105	12,111	-	-
1971	2,909	6,007	2,227	11,143	112	11,255	-	-
1972	2,379	5,787	1,766	9,931	115	10,046	-	-
1973	2,310	5,677	2,103	10,089	91	10,181	-	-
1974	2,847	6,807	2,256	11,909	111	12,020	76.4	157.3
1975	2,905	6,096	2,286	11,287	117	11,404	78.5	145.3
1976	3,282	7,158	2,323	12,763	219	12,981	79.9	162.5
1977	3,059	7,017	1,677	11,753	259	12,012	81.8	146.8
1978	3,153	7,541	2,275	12,969	355	13,324	83.7	159.2
1979	3,341	7,548	1,960	12,849	494	13,343	85.6	155.9
1980	2,854	7,420	2,466	12,740	823	13,563	87.7	154.7
1981	3,289	7,963	2,631	13,882	1,092	14,975	90.8	164.9
1982	3,270	7,209	3,152	13,630	967	14,598	93.2	156.6
1983	3,067	7,603	3,546	14,216	1,095	15,311	95.6	160.2
1984	3,222	7,936	3,350	14,508	1,211	15,719	98.1	160.2
1985	2,783	7,931	3,909	14,623	1,464	16,087	100.6	159.9
1986	2,827	8,540	3,670	15,037	1,042	16,079	103.1	156.0
Annual trend growth rate [%]: /*								
1961-86	0.91	0.79	8.92	1.82	18.33	2.17	2.53	-0.26
1974-86	-0.15	1.83	5.80	2.20	24.62	2.93	2.56	0.36
1978-86	-1.34	1.23	8.50	2.13	14.93	2.75	2.69	0.06
1981-86	-3.35	1.96	6.65	1.82	3.22	1.94	2.58	-0.62

/* Trend growth rates are computed using the semi logarithmic trend equation fitted to the time series data based on the least squares method.

/- Reliable data not available.

Data source: BDG Food Directorate; World Bank; BBS Bulletin; USAID, Dhaka.

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Even though Bangladesh is one of the largest rice producing countries in the world, both in terms of total production and acreage, ironically, it is also one of the largest importers of foodgrains and a recipient of food aid. The need for imports stems not only from the failure of the agricultural sector to produce required amount of foodgrains for the rapidly growing population but also due to the vagaries of nature resulting in crop failures and food scarcities off and on. Foodgrain imports in Bangladesh steadily increased from an average of 0.6 million tons in 1960-65 to about 2.6 million tons in 1984-85. Due to the ongoing unprecedented flood, it is widely speculated that the foodgrain imports may well exceed 3 million tons this year (1987-88). The future prospects for rice and wheat production in Bangladesh do not appear to be too bright either. Most of the projection studies (Islam and Ahsan, 1978; Hamid, 1980; Jahan, 1985) predict that the gap between the demand for foodgrains and domestic supply will not only tend to persist but may even widen in the years to come.

According to the USAID estimates the total foodgrain requirements in the country in the year 2000 may stand at 22.7 million tons, 23.1 million tons and 28.9 million tons under alternative assumptions of per capita per day requirements of 15.72 oz, 16.00 oz and 20.00 oz, respectively (Table 1.2).

If one assumes a 2.5 percent annual rate of foodgrain production growth between FY 1986 and 2000, the deficit will be to the tune of 1.8 million, 2.2 million and 8.0 million tons in the year 2000 under three assumptions of nutritional requirements mentioned above (Figure 1.1). This implies that the present rate of increase in foodgrain production would not

make the country self sufficient in food and would fail to satisfy even the basic metabolic requirements of the population by the turn of the century.

A 4-5% growth rate in production is necessary to achieve self sufficiency at 15-16 oz/cap intake of cereal grain.

Table 1.2. Foodgrain Production, Import and Consumption Requirements in Bangladesh

Year	Foodgrain Production (000 MTs)	Foodgrain Imports (000 MTs)	Population est./proj. (000 Nos.)	Foodgrain Requirmt./a (000 MTs	Foodgrain Requirmt./b (000 MTs)	Foodgrain Requirmt./c (000 MTs)
1974-75	11,404	2,319	78,460	16,238	12,990	12,763
1975-76	12,981	1,515	79,900	16,536	13,228	12,997
1976-77	12,012	791	81,800	16,929	13,543	13,306
1977-78	13,324	1,705	83,700	17,322	13,858	13,615
1978-79	13,343	1,165	85,600	17,715	14,172	13,924
1979-80	13,563	2,771	87.700	18,150	14,520	14,266
1980-81	14,975	1,076	89,947	18,617	14,892	14,631
1981-82	14,598	1,256	92,159	19,073	15,258	14,991
1982-83	15,311	1,843	94,426	19,524	15,633	15,360
1983-84	15,719	2,028	96,749	20,023	16,018	15,738
1984-85	16,087	2,590	99,129	20,515	16,412	16,125
1985-86	16,079	1,202	101,567	21,020	16,818	16,521
1986-87	-	-	103,940	21,511	17,209	16,907
1987-88	-	-	106,369	22,013	17,611	17,303
1988-89	-	-	108,855	22,528	18,022	17,707
1989-90	-	-	111,399	23,054	18,444	18,121
1990-91	-	-	114,002	23,593	18,875	18,544
1991-92	-	-	116,678	24,147	19,318	18,979
1992-93	-	-	119,417	24,714	19,771	19,425
1993-94	-	-	122,219	25,294	20,235	19,881
1994-95	-	-	125,088	25,887	20,710	20,348
1995-96	-	-	128,024	26,495	21,196	20,825
1996-97	-	-	130,872	27,084	21,668	21,288
1997-98	-	-	133,783	27,687	22,150	21,762
1998-99	-	-	136,759	28303	22,642	22,246
1999-2000	-	-	139,801	28,932	23,146	22,741

/a Calculated by considering INFS standard of nutritional requirement (2273 calorie/day/a person) of which 86% (20 oz./person/day) assumed to be shared by foodgrains.
/b Calculated by BDG food requirement target of 16 oz/person/day.
/c Calculated by IBRD's standard food requirement of 15.72 oz/person/day.

Population projections for 1982-2000 were made by the USAID/Dhaka (P&H) assuming mode fertility decline where annual average exponential growth rates stand as 1981-86 = 2 1987-91 = 2.31%, 1992-96 = 2.32% & 1997-2000=2.20%.

Source : USAID

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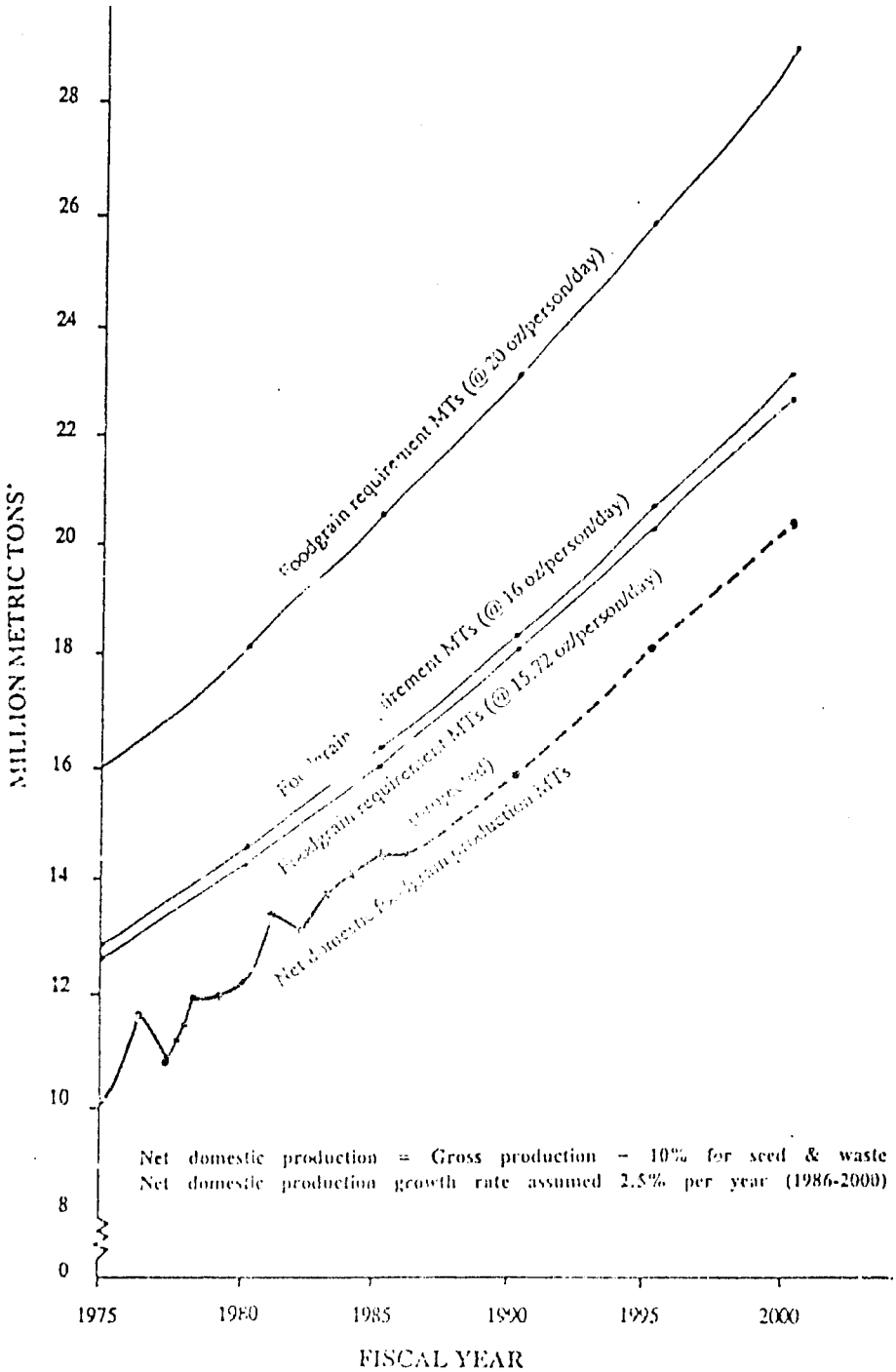

Fig. 1.1. Food Gap in Bangladesh (FY 1975-2000)

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A big push will therefore be required to generate requisite rate of production growth if the elusive goal of self sufficiency in food is ever to be achieved (Hamid 1980). Against the backdrop of the prevailing agricultural scenerio in the country the same will indeed be a formidable task.

Foodgrain production in Bangladesh is severely constrained by limited land resources and climatic uncertainties. Above all, excessive reliance on rice-wheat cultivation itself seems to have aggravated the problem. In addition to having slow growth, rice production has been unstable too. The performance of Amon has been poor and unreliable while Aus has shown an outright negative growth trend over the years. The relatively better rates of growth exhibited by Boro rice and wheat in the seventies seem to be tapering off (Fig. 1.2).

1.2 Crop Diversification

Crop diversification has been recognized to be a key intervention to increase food production (BARC, 1982; Kaul, 1983; IBRD, 1985, Hurdus, 1986). Besides relieving pressure from rice and wheat, it will provide foodgrains oriented to the needs of the poor and nutritionally deficient people (World Bank, 1985). However, the success of crop diversification will depend upon a number of factors such as availability of land, technology, economic profitability and marketing prospects. Although the availability of land in Bangladesh remains limited, there seems to be considerable scope for crop diversification through bringing fallow and under utilized land under cultivation. The level of scientific knowledge and technology in

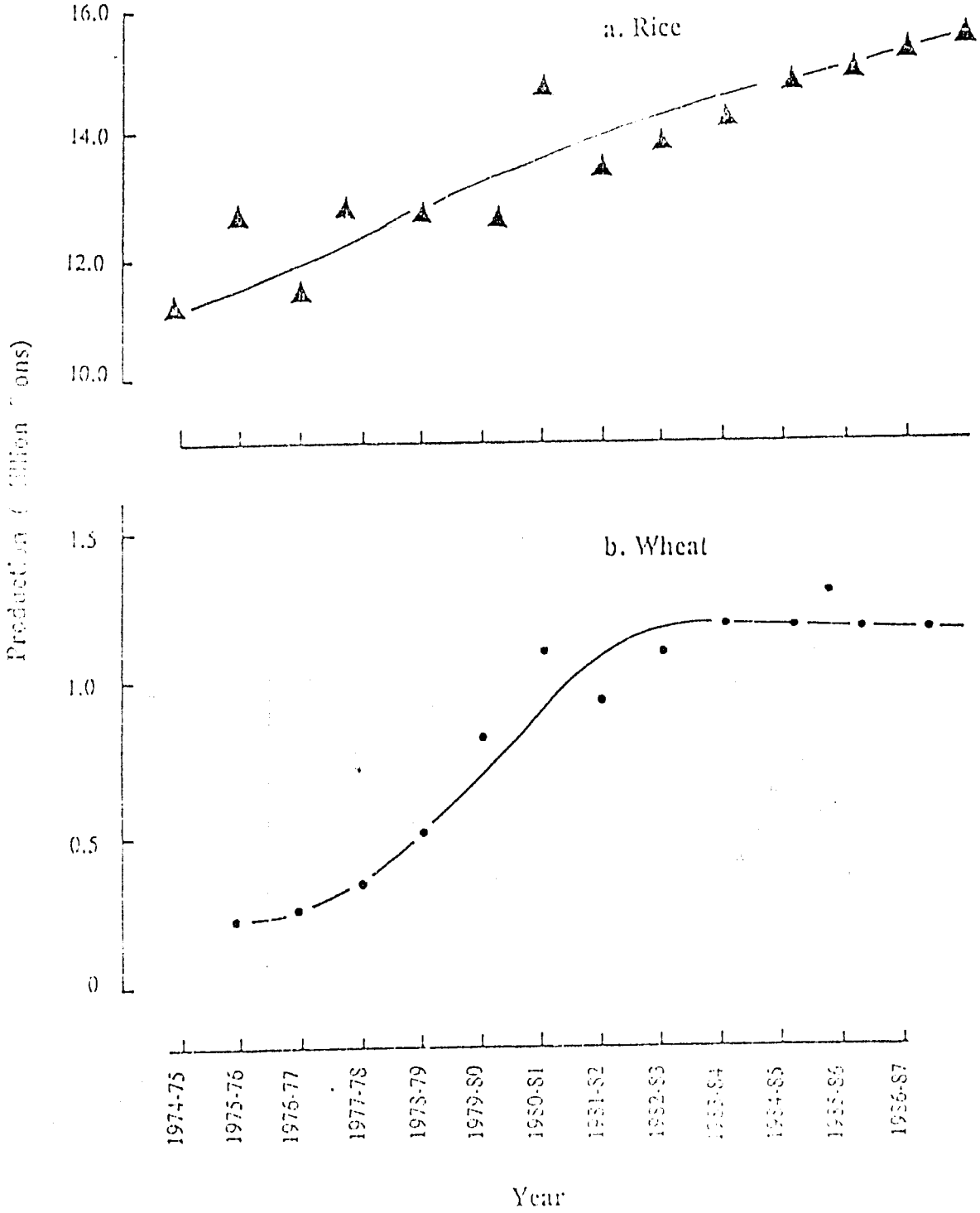

Fig. 1.2. Rice and Wheat Production in Bangladesh

Bangladesh seems to be adequate enough to launch a program of crop diversification. Crops which are quick maturing, high yielding and profitable are more likely to succeed. In view of the ever increasing need for food due to rapid population growth, the prospect of food cereals remains high in this regard. However, for unconventional food crops promotional and income generation measures are needed to create market demand and consumer preference. Finally, a policy of crop diversification will demand a firm commitment of the government for providing institutional infrastructures for research, extension, input supply, credit and marketing (BARC, 1982).

It has been recognized that among the coarse grains with which the farmers of Bangladesh are somewhat familiar, maize has the greatest potential to become a supplementary staple food, particularly among the disadvantaged and vulnerable groups languishing under extreme poverty. Already about a million people of tribal and Bihari origin in Bangladesh are culturally accustomed to eating maize as a staple. However, the success of maize to become a major cereal will depend on its acceptance by the people at large. The same can be achieved through a well orchestrated maize promotional program in the country. The merits of maize as the possible third cereal crop of Bangladesh are given elsewhere in this report.

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2. PUBLIC FOOD DISTRIBUTION SYSTEM (PFDS)

2. PUBLIC FOOD DISTRIBUTION SYSTEM

Although bulk of the foodgrains in Bangladesh are traded through free market mechanism, the public food distribution system (PFDS) plays a significant role in influencing the prices and the market. The PFDS basically depends upon three programs: imports, domestic procurement and distribution. The PFDS handles about 13 to 15 percent of all foodgrains consumed in the country and serves about 25 percent of the population. About 75 percent of the foodgrains under the distribution program are imported and the rest are procured from domestic sources (Khaleque, 1983).

The Government of Bangladesh imports bulk of foodgrins through credit and grants. The principal donor countries are USA, Canada, Australia, Japan and the EEC. Cash purchases are usually made from Thailand, Burma and USA. Wheat constitutes about 80 to 90 percent of the total grain imports.

2.1 Internal Food Procurement

The main objectives of the internal foodgrain procurement program are: encouraging production through price incentive to growers, stabilizing prices and ensuring adequate supplies for the rationing system. The procurement program is carried out by the Ministry of Food through a countrywide net work of procurement centres having storage facilities. In 1986-87 the amount of procured rice/padds and wheat stood at 129 and 53 thousand tons, respectively (Table 2.1). The low volume of procurement may be attributed to the higher open market prices than the procurement prices fixed in most of the years (Table 2.2).

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Table 2.1. Public Foodgrain Distribution and Management in Bangladesh, FY 1973-1988

['000 Metric Tons of Rice & Wheat]

Source & channel\ FY	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988/p
Opening Stock	278	302	217	751	853	382	678	212	791	1,249	618	611	800	1,017	976	692
Domestic Procmnt.	*	72	130	422	319	559	359	355	1,033	302	192	270	344	350	182	392
Rice	..	..	..	..	..	548	304	230	654	289	168	148	134	220	129	230
Wheat	..	..	..	..	..	11	54	125	179	13	24	122	210	130	53	162
Yearly Imports	2,871	1,692	2,319	1,515	791	1,705	1,165	2,771	1,078	1,256	1,843	2,028	2,590	1,202	1,767	2,355
TOTAL AVAILABLE:	3,149	2,066	2,666	2,638	1,973	2,648	2,201	3,338	2,500	2,807	2,651	2,909	3,734	2,569	2,925	3,429
Offtakes:																
Statutory Rationing	472	502	478	340	383	458	424	499	348	312	338	293	276	150	210	166
Modified Rationing	1,518	736	544	504	293	358	317	391	182	431	358	399	464	103	257	329
Essential Priorities	–	–	107	97	97	124	98	85	90	103	98	108	112	117	118	124
Other Priorities	–	–	252	247	231	333	398	547	353	382	343	344	388	210	389	368
Large Employer	–	–	92	87	62	91	77	108	31	57	77	60	63	36	38	54
Flour Mills	–	–	133	165	170	216	166	181	127	125	129	128	168	104	123	123
Market Operation	–	–	–	–	–	5	9	10	*	110	*	51	8	50	40	0
Open Market Sale	–	–	–	11	59	–	54	118	*	47	118	107	201	57	217	248
F F W & Canal Digging	–	–	–	47	169	259	219	448	355	372	411	441	573	468	508	499
Relief/1	210	53	163	182	33	31	45	52	51	73	84	120	340	205	221	251
Others /2	360	464	–	–	–	–	–	–	–	–	–	–	–	–	–	–
TOTAL DISTRIBUTED:	2,560	1,755	1,769	1,580	1,497	1,577	1,825	2,440	1,547	2,072	1,938	2,051	2,573	1,540	2,119	2,152
Losses	187	94	136	155	94	91	164	107	104	99	104	58	144	53	114	152
Export & Re-payments	–	–	–	–	–	–	–	–	--	20	–	–	–	–	–	–
CLOSING STOCK:	302	217	751	853	382	678	212	791	1,249	618	611	800	1,017	976	692	1,115

* Less than 1000 MTs. /p = WFP Projection (08/05/87).

.. Breakdowns not available.

/1 Includes Test Relief, Gratuitous Relief, & Vulnerable Group Feeding.

/2 Includes other than SR, MR & Relief.

Source: WFP; WORLD BANK; & USAID,Dhaka.

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Table 2.2. Procurement and Market Prices for Coarse Rice and Wheat in Bangladesh (1983-87)

(Taka per maund)

Year a/	Rice		Wheat	
	Procurement	Market b/	Procurement	Market b/
1983	215	224	136	146
1984	225	274	144	159
1985	248	257	162	157
1986	265	295	180	185
1987	308	332	200	201

Notes:

a/ July price

b/ Average minimum price

Source: USAID

2.2 Rationing Program

Foodgrains procured from external and domestic sources are distributed through a rationing program which was originally designed to serve mostly the urban people. In recent years, however, the base of PFDS has been broadened in an attempt to reach wider areas and broader categories of people. At present the PFDS has 12 channels of distribution of which the following are more important:

(1) Statutory Rationing (SR), (2) Other Priorities, (3) Modified Rationing (MR), (4) Open Market Sale (OMS), (5) Food for Work Program (FFWP) and (6) Vulnerable Group Feeding Program (VGFP) and Gra. :tous Relief.

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Statutory Rationing (SR) covers six cities: Dhaka, Chittagong, Khulna, Narayanganj, Rangamati and Rajshahi. The consumers most of whom are government employees, in these cities are provided with ration cards on which they can draw rations every week. More than four million people are believed to receive Statutory Rationing.

Other priorities is a rationing program similar to SR, except that it operates in the urban areas outside the six SR cities. About six million people most of whom are goverment servants, are covered by this priority program.

Modified Rationing (MR) is meant to serve the rural areas. The recipients are classified into four categories based on their income. Preference is to be given to those who pay no taxes at all and are considered to belong to the poorest starta. However, MR operates more sporadically than the urban rationing programs.

2.3 Open Market Sale

Open Market Sales (OMS) programs undertaken by the Government are aimed at stabilizing foodgrain prices in the market. The mechanism is designed to arrest the increases in rice and wheat prices during lean season through stockpiling and subsequent release (sales at or near prevailing market prices) of the stocks when prices are high.

2.4 Food For Work Program

The objectives of the food for work (FFW) program (FFWP) are three fold: relief, employment and development. The FFWP program is mainly supported by the USAID (with CARE in the management) and World Food Program (WFP). The program is implemented by local officials through coordination

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of relevant ministries. The FFWP uses wheat provided by donor agencies as well as wheat from the government's own stock (Table 2.3).

Table 2.3. Wheat Allotment [illegible] FFW in 1984-85

Donor/head	No. of upazila	No. of Projects	Wheat allotment ('000 m.t.)
USAID	321	951	149.0
Govt. (general)	481	1594	59.2
WFP (Local projects)	126	715	59.5
WFP (BWDB projects)	-	-	82.5
WFP (Emergency flood relief)	-	-	25.0
Bilateral aid (Canada, West Germany & Australia)	147	1241	61.4
Flood & Natural Calamity relief	-	-	29.4
Total:		4501	457.0

Note: Actual wheat use was one thousand tons higher than the allotment. Massive food aid after the flood in 1984 resulted in higher distribution of wheat in this year.

Source: Hassan & Karim, 1987.

Under this program landless labourers in rural areas are provided employment during the non-agricultural season and payment is mostly made in the form of wheat. In recent years FFWP has turned out to be the most important employment generation program in rural Bangladesh. It is also making available foodgrains to the poor people in the rural areas particularly during the period when landless labourers face seasonal unemployment. In 1982-83 about 0.4 million tons of wheat were distributed and about 2.3 million people were provided employment (World Bank, 1985).

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This program has also considerably increased the average intake of wheat for the FFW families (133.2 g daily in contrast to national intake of 31 g - Hassan & Karim, 1987).

FFW projects are carried out both in the dry and rainy seasons. The rainy season FFW is known as test relief. A recent program included in the FFW is the use of destitute women of year-round maintenance work.

2.5 Vulnerable Group Feeding Program

The vulnerable group feeding and gratuitous relief programs provide foods to high risk disadvantaged groups. The vulnerable groups include destitute women particularly in rural areas, and also pregnant and lactating mothers with their children. About 1.1 million beneficiaries receive wheat from this program. Moreover, there is group feeding program for orphans financed by the World Food Program.

An evaluation team on the VGFP program in 1980 expressed satisfaction with its overall performance and concluded that the VGFP contributed to reducing the hunger of many needy women and children (World Bank, 1985).

Gratuitous relief provides relief to victims of natural disasters like flood, cyclone and famine. The amount of relief provided varies from year to year depending upon the nature and severity of the calamities.

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2.6 Distribution of Food Under PFDS

The year wise distribution of foodgrains to different categories under the PFDS is shown in Table 2.1. In the year 1986-87, 216 thousand tons of food grains (10% of the total offtake) went to SR, 257 thousand tons (12%) to MR, 507 thousand tons (24%) to priority groups, 217 tons (10%) to OMS, 503 thousand tons (24%) to FFWP and canal digging and 221 thousand tons (10%) to relief (test relief, gratuitous relief and VGFP). Figure 2.1 summarizes the status of sources and beneficiaries of foodgrins handled through the PFDS in 1986-87.

2.7. Distribution of Maize Under PFDS

As was mentioned earlier, so far PFDS has handled only wheat and rice. However, it should be possible to adopt the same mechanism to maize as long as the form, target populations, price and volume are determined well in advance and necessary extra care is taken in handling and storage of maize.

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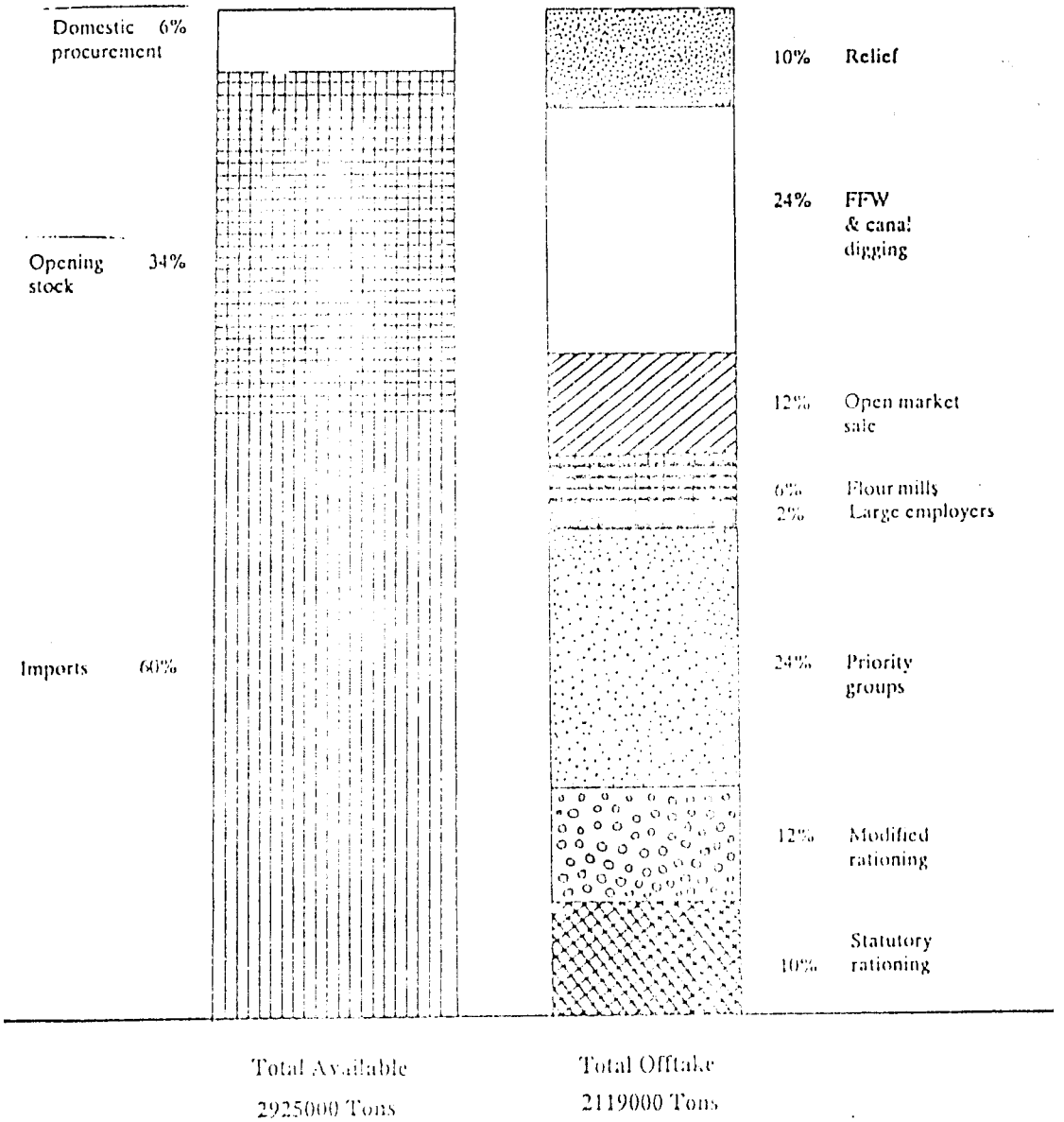

Fig.2.1. Availability and Distribution of Food Grains in Bangladesh (1986-87) under Public Food Distributon System (Based on Data from USAID-1987)

3. MAIZE IN BANGLADESH

3. MAIZE IN BANGLAGESH

3.1. Historical

Maize has always been a minor crop in Bangladesh. Some hill tribes have been utilizing it for ages as a staple. Official statistics on area and production are not reliable. Sporadic attempts were made in the early sixties and eighties to popularize the crop. In 1960-61 the Governor of East Pakistan was very enthusiastic about maize. He ordered the crop to be planted on every vacant piece of land (Pray et al, 1981). The officials, farmers and/or statisticians responded to this order resulting a peak in the production in 1961 (Figure 3.1). Another push came in 1979-80 when seed was imported from outside and a Ford Foundation grant was made to Bangaldesh Agricultural Research Institute. Simultaneously, the demand for maize grew with the establishment of several poultry farms and a dairy farm at Savar. Soon it was realized that local preduction of maize would not meet the demand from the poultry and livestock industry. However, maize never assumed a significant role in direct human consumption except for a small but firm urban demand for green cobs.

In 1985 the Ministry of Agriculture set up a Task Force on maize to look into the various aspects of its production and utilization in the country. This Task Force had at its disposal a number of studies conducted on the agronomic and socio-economic aspects of maize production in Bangladesh. The committee has held four meetings to date providing guidelines to the research and extension agencies in the country. The Department of Agricultural Extension launched a maize production program in the Kharif-1 season of 1987, upon the recommendation of this committee.

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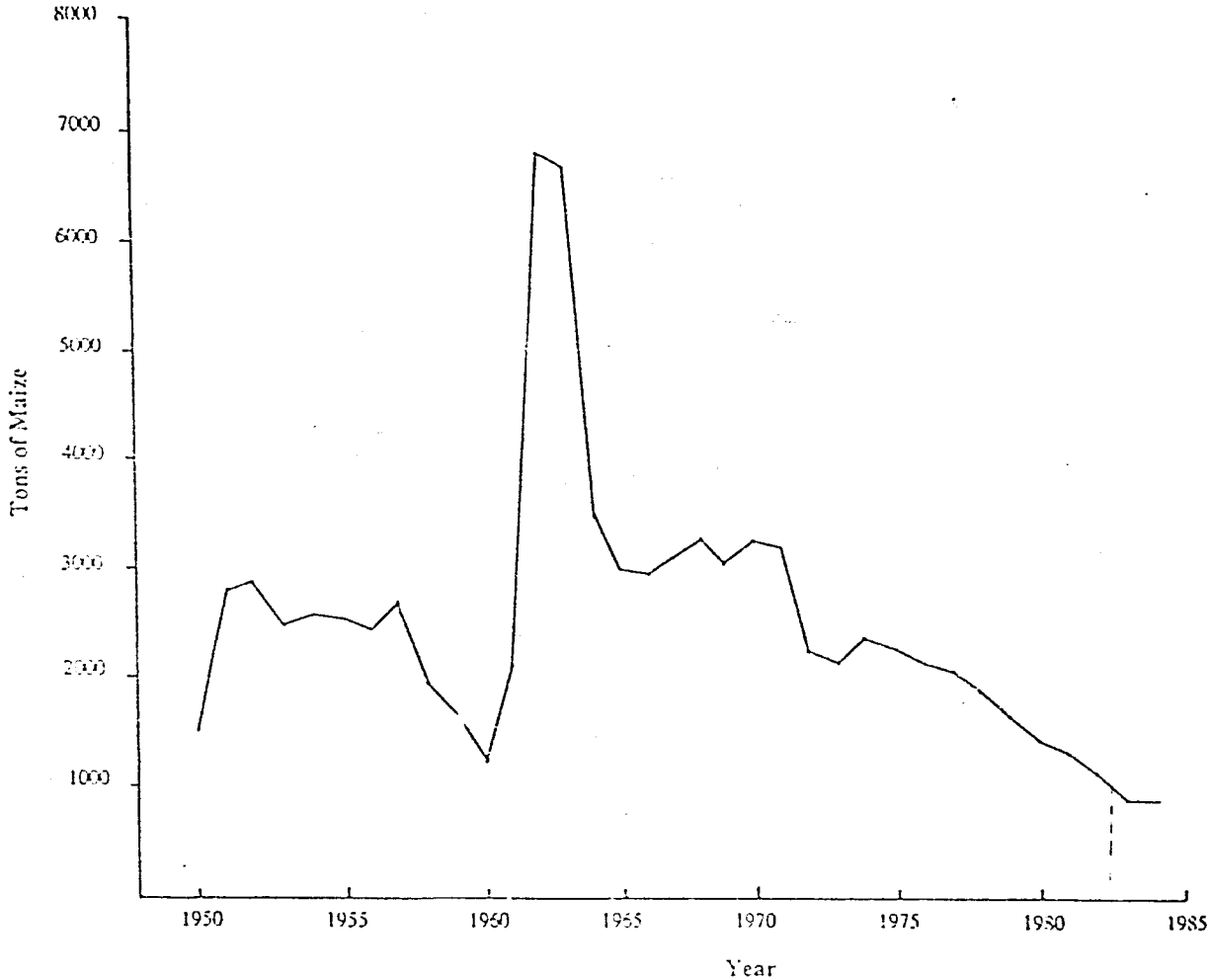

Fig.3.1. Trend of Maize Production in Bangladesh (1950-84)

The arrangements made aimed at producing maize on 1,000 acres in 20 districts. In addition to serving the purpose of demonstration, farmers' training was considered as an important objective. The Phoenix Poultry Ltd. had given assurance to purchase the entire produce at Taka 175 per maund. From our discussions with the Extension Directorate personnel we understand that the program was successful. It appears that the growers in certain areas found better price for maize from the local consumers (i.e. direct human consumption) than the price fixed in the beginning (see Annex 3.1a and b).)

During the writing of this report the authors came across several newspaper reports on the bright prospects of maize in a number of areas (Annex 3.2). We were also told that the Bangladesh Poultry Development Association had approached the Ministry of Fisheries and Livestock to help them import 10,000 tons of yellow maize from abroad (Annex 3.3). We found reference to an earlier request made by the Ministry of Fisheries and Livestock to the External Resources Division (Ministry of Finance) for the import of 10,000 tons of maize in September 1985. It seems that the private poultry farm owners are interested in replacing wheat with maize in the poultry feed. The same is not surprising since maize provides more energy per unit weight of grain and has high B-carotene content which is desired for better nutrition and egg yolk colour.

Poultry farmers as well as extension authorities claim that a number of government-owned large under-utilized farms could be commissioned to produce high quality maize for the use of government as well as privately owned poultry farms with fully assured demand. They estimate that at least

4,000 acres of such farm land is available for immediate use for this purpose. We recommend that this claim should be verified. If found correct, high quality maize could be produced in the first phase of the intensive maize production program proposed in this study.

In the wake of the prevalent emergency situation arising due to unprecedented floods in the country, we were told that, some quantity of maize seed was being procured by the Ministry of Agriculture for planting in the flood affected areas upon the receding of waters (personal communication with the Secretary of Agriculture). We are convinced that this time, consumers as well as the Government of Bangladesh are serious about exploring the prospects of consuming and producing maize.

3.2. Assumed Constraints to Maize Production and Utilization

Maize is not a major cereal in Bangladesh. At present its area, production and demand are limited although its potential for food, feed and industrial use are fully acknowledged by policy planners. Limited production and marketing demands are believed to be due to many factors. The most often cited constraints are listed:

- Suitable land is not available (False): It is said that maize cultivation will have to replace a number of more profitable alternative crops. All the studies conducted in recent years on the prospects of maize have concluded that maize can come up as the major third cereal without replacing any major crop. It has been estimated that with careful land budgeting between 2.3 to 5.5 million hectares of land could be used for maize cultivation (Islam and Kaul, 1985; AST reports, [illegible]). Ikal (1986) has

concluded that 200,000 hectares of land would be enough to rank maize as the major third cereal crop by the year 2000. In our conservative estimates we have made gradual projection for production targets estimating between 60 and 70 thousand tons to be produced towards the end of this century. No more than 20 to 30 thousand hectares would be required to achieve these targets (Table 4.3).

- Maize would not fit into existing cropping patterns (False): No other cereal crop offers as much flexibility as maize. Judiciously planted early maturing varieties can be used as sole, mixed or inter-crops in the current fallow land, in less productive Aus land and land available for cultivation soon after the receding of monsoon waters. Upto 20 percent inter-cropping can be practiced with chillies, onions, amaranthus, spinach and some pulses. In Chittagong division alone some ten thousand hectares of chilli land can be inter-cropped with maize. In this division potato-maize-T. Aman rotation has been found to be profitable (Table 3.1).

- Bangladeshis being rice eaters would not consume maize (False): Bangladeshis were not wheat eaters till 1974. Now all strata of society consume wheat, willingly. A well organized promotion campaign for maize might achieve similar results. Moreover, while wheat can only be eaten as bread and Chapati, maize could be consumed in numerous ways. It has the flexibility to suit the preferences of all, rich and poor.

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Table 3.1. Possible Association of Maize with other Crops in Bangladesh

Target Area		Crop combination
Flood-prone districts	1.	Maize (grain) -Deepwater Aman
	2.	Maize (Fodder/Green cobs) - HYV Boro
	3.	Maize (Fodder/Green Cobs) -Spices
	4.	Maize (Fodder) - Wheat.
Winter fallow (medium high land)	1.	Maize (Fodder) - Potato - T. Aman
	2.	Maize - Summer vegetables - T. Aman
	3.	Oilseeds - Maize - T. Aman
	4.	Maize - Jute
	5.	Maize - HYV Boro
	6.	Wheat - Maize
Winter fallow (medium low land)	1.	Maize - Aus/Broadcast Aman
	2.	Maize (Fodder/Green cobs) - Boro
	3.	Maize (green cobs) + Pulses (intercrop) - Boro
	4.	Maize (Fodder/Green cobs) - Sweet Potato-Peanut
Substitute of Local aus land	1.	Pulses/Oilseeds - Maize - T. Aman
	2.	Maize - Sorghum/Millet - T. Aman
Govt. khas land	1.	Maize (Winter) - Maize (Summer)
	2.	Maize - T. Aman
	3.	Pulses/Oilseeds - Maize - T. Aman
	4.	Wheat - Maize
	5.	Potato - Maize
	6.	Winter vegetables - Maize - T. Aman
Hilly districts	1.	Maize - Summer rice/Seseame.
	2.	Maize - Summer vegetables
	3.	Winter vegetables - Maize.

Source: Various published and unpublished reports.

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- Maize is not well known to farmers and consumers (True): With a well organised and sustained efforts by the Ministry of Food and by the Ministry of Agriculture it can be popularised amongst producers as well as consumers in a short period of time.

- There is a lack of a firm government policy (True): So far there has been only sporadic, limited and non-sustained commitment from the government. Most government agencies and policy makers are now convinced about the value of maize. A well concerted inter-ministerial program and campaign need to be initiated to achieve long lasting success.

- Research program is weak (True): Limited funds, manpower and time have been spent on the various aspects of maize development in Bangladesh. Moreover, research effort has not been sustained leading to frequent disruptions in research activites. A firm and reliable coordinated program with several objectives and inter-institutional links should be launched. It should encompass both production as well as consumption aspects.

- There is a lack of quality seeds (True): In the absence of a reliable indigenous research program quality seed has never been produced in requisite quantities to ensure the production needs. Seed has been imported several times but without systematic plans or targets. The seed requirements being

meagre for the projected production targets, it should be possible to establish a reliable seed production base with limited research.

- There is a lack of inputs (True): Not having been recognized as an important crop, government has not formulated any input policy for maize as yet. One can expect that a favourable input policy would be laid down once merits of this versatile crop are realized. It would be useful to provide cash or other incentives to maize farmers.

- Maize has never been promoted as a nutritious food (True): There is a false notion in Bangladesh that maize is meant for cattle and poultry and for poor people during emergency. This myth can be altered only through a well organised campaign to convince the masses that maize can be eaten by all strata of the society as a major staple.

- There is lack of marketing and pricing policies (True): In the absence of a sizeable quantity being produced and consumed, it is natural that neither the farm gate nor consumer prices were set. With increase in production, and when reasonable volume of maize appears in the market, a pricing structure will automatically appear. In the beginning, however, the government may need to lay some guidelines to balance the interests of producers and consumers.

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- There is lack of technology for shelling, drying and storage (True): The research program, already in vogue did not pay much attention to these important post-harvest issues. High importance would need to be given to this area of research and development.

- Maize is a highly fertilizer and water intensive crop (False): Compared to rice, water requirements of maize are only 38 percent. It requires only 368 kg of water to accumulate 1 kg of dry matter against rice and wheat which use 975 and 514, kg respectively. Water requirements of the various crops are listed in the Table 3.2.

  Maize can give higher productivity per unit of fertilizer than other major crops. What is important to emphasize is the capability of Maize plant to yield well under poor input conditions. It is true that Maize responds well to fertilizers but it is not any more exhaustive than wheat or rice (Table 3.3).

  It is evident that most crops including soybean, potatoes and wheat require more water than maize.

The existing constraints to maize production have been dealt in detail by Islam and Kaul (1986). They have concluded that none of the issues could be considered truly as constraints. Good planning, a coordinated approach and concerted effort should remove the bottlenecks, leading to a successful maize production and utilization program in Bangladesh. All the analyses done on the production

potential, economic profitability and market potential have resulted in positive recommendations. More studies need to be performed to answer specific questions on pricing and demand. In the initial stages, government may need to set a procurement price for maize to protect the farmers' interest. It would not cost much to the government at this stage since the volume to be procured will be limited.

Table 3.2. Water Requirement of Major Crops to Produce a Kilogram of Dry Mater

Crops	Kg water used per kg of dry matter produced.	Index (rice as 100)
Rice	975	100
Soybeans	650	67
Potatoes	580	59
Oats	580	59
Wheat	550	56
Barley	434	45
Maize	368	38
Sorghum	300	31

Source: Chr[illegible]ds and Sadara, 1977; House, 1985.

Table 3.3. Nutrient Removal by Crops[1], in Kilograms per Hectare

Crop	Yield	Nitrogen (N)	Phosphorus P_2O_5	Phosphorus (P)	Potassium K_2O	Potassium (K)	Ca	Mg	S
	kg/ha								
Rice (paddy)	3 000	50	25	11	80	66	—	—	—
	6 000	100	50	22	160	133	19	12	10
Wheat	3 000	72	27	12	65	54	—	—	—
	5 000	140	60	26	130	108	24	14	21
Maize	3 000	72	36	16	54	45	—	—	5
	6 000	120	50	22	120	100	24	25	15
Potatoes	20 000	140	39	17	190	158	2	4	6
	40 000	175	80	35	310	257	—	23	16
Sweet potatoes	15 000	70	20	9	110	91	—	—	—
	40 000	150	75	33	390	324	28	9	—
Cassava	25 000	161	39	17	136	113	44	16	—
	40 000	120	70	31	350	291	57	—	—
Sugar cane	50 000	66	50	22	150	125	—	—	—
	100 000	110	90	39	340	282	—	50	38
Onions	35 000	120	50	22	160	133	—	—	21
Tomatoes	40 000	110	30	13	150	125	—	17	54
Cucumber	35 000	60	45	20	100	83	—	36	—
Alfalfa (hay)	7 000	[2]215	60	26	130	108	154	19	19
Soybeans	1 000	[2]160	35	15	80	66	—	—	—
	2 400	[2]224	44	19	97	81	—	18	—
Beans	2 400	[2]155	50	22	120	100	—	—	-
Groundnuts	1 500	[2]105	15	7	42	35	19	11	12
Cotton (seed + lint)	1 700	73	28	12	56	46	6	4	5
	5 000	180	63	27	126	105		25	30
Tobacco (dry leaf)	1 700	[2]	22	10	129	107	48	6	4

— Data not available

[1] Plant nutrients contained in the above-ground plant part, and the below-ground harvested portion where appropriate, at the indicated yields. Note that these are not the same as fertilizer requirements.

[2] Leguminous crops can get most of their nitrogen from the air.

Source: Directly reproduced from FAO, Fertilizer and Their Use : A pocket guide for extension officers, FAO Land and Water Development Series, No.8, Rome, Italy, 1983, P.28

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3.3. Merits

There are a host of reasons for advocating production and consumption of maize in Bangladesh. The same could be categorized into three major areas discussed below.

3.3.1. High yield and profitability:

Maize, being a C-4 crop, is more efficient in converting solar energy to bio-mass than many other crops (Table 3.4).

Table 3.4. Interspecific Differences in Photosynthetic rates

Crop Species	Range of Mg CO_2/hr
Soybean	12 - 24
Cotton	24 - 45
Alfalfa	20 - 50
Rice	35 - 62
Maize	28 - 75

It responds well to fertilizer and irrigation application. Maize possesses incredible adaptibility; it is cultivated in a wide range of latitudes and altitudes. Being photo - insensitive it can be grown throughout the year and can fit into wide range of cropping patterns, including inter and mixed crop conditions. Unlike rice, it does not require large quantities of water and unlike wheat it does not require a cold temperature spell. It can be grown equally well on fine sandy-loam and heavy clay-loam soils from moderately acid (pH5.0) to moderately alkaline (pH8.5)

soils. Since the worst areas of Bangladesh have mainly loam soils with a pH range from 5.5 to 7.0, maize can be grown throughout the country. The crop can withstand from draughty to high moisture conditions (200 mm to 5000 mm of rainfall). In the summer season, it can grow under well-drained condition and in the winter season it can manage under modest moisture condition.

Maize has the advantage of maturity/use flexibility. If it fails as a grain crop, farmers will still get reasonable returns in the form of fodder and fuel. It could be used in the green cob stage or harvested even earlier at 60 to 80 days for fodder and silage. Therefore, total crop failure in maize is most unlikely.

The greatest advantage of maize crop over rice and wheat lies in its high bio-mass potential. Maize grain carries more calories on equivalent dry weight basis, the yields under ideal conditions going upto 14 tons per hectare. Very high yields have been reported under farmers' fields and experimental stations conditions (Islam and Kaul, 1986; Mohammad, 1985). The fodder potential of maize is well known. It is particularly preferred as whole plant silage. Stovers of maize can be used as a fuel, which on dry weight basis have 75 percent of the energy of coal.

The success of a crop for adoption among farmers depends upon its expected profitability which is determined by the projected cost of production, yield and prices or other

values of the products. Yields of new maize varieties have been found to be considerably more than those of Boro and Wheat. The costs of production are also relatively much lower. Several studies (World Bank, 1985; Elias et al; 1985) have reported that the benefit cost ratios for maize are favourable. Table 3.5 confirms better performance of maize in terms of benefit-cost ratios compared to many other crops.

Table 3.5. Benefit/Cost Ratio of Some Crops of Bangladesh.

Crop		Benefit/ Cost ratio* Full cost basis	Cash Cost basis
Boro	Local	1.2	-
	HYV	1.0	1.8
T. Aus	Local	1.5	4.4
	HYV	1.7	3.2
B. Aus	Local	1.5	3.9
	HYV	2.1	5.5
T. Aman	HYV	3.2	-
Wheat		1.1	1.8
Sugarcane		1.5	2.1
Groundnut		1.8	3.1
Vegetables (Average)		2.0	4.2
Gram		0.7	1.5
Lentil		0.9	2.3
Mustard		1.4	3.1
Potato		1.7	2.8
Tobacco		2.6	6.6
Maize Grain		2.5	-
1:1 Grain/cobs		2.8	-
Cobs		3.2	-
Summer Pulses **		1.5	2.6

Source : Based on various reports.

* Cash cost includes out of pocket expenses only.

** 60 day crop.

In conclusion it can be said that maize far excels other cereal crops in its agronomic adaptibility, yielding capacity and bio-mass use.

3.3.2. Multiplicity of use:

Maize yields more food and industrial product than any other grain. Its stalk leaves, silk, cobs --- all have commercial value, although that of the kernels is by far the greatest. Figure 3.2 lists some of the products of maize and Figure 3.3 outlines processes involved in producing a myriad of products from mMaize grain. Annex 3.4 lists several hundred products, by products and raw materials based on maize. Maize is eaten in more varied forms than any other food crop. Compared to wheat it offers more flexibility to Bangladeshi housewives in experimenting with its preparations.

3.3.3. High nutritional value:

Maize kernel is one of the most efficient capsules of food designed by nature. It is a high energy food having highly digestible carbohydrates, good protein content and amino acid profile; oil obtained from its germ is cholesterol free. Maize is fairly rich in vitamin B and yellow kernel types are particularly rich in pro-vitamin A carotenes which

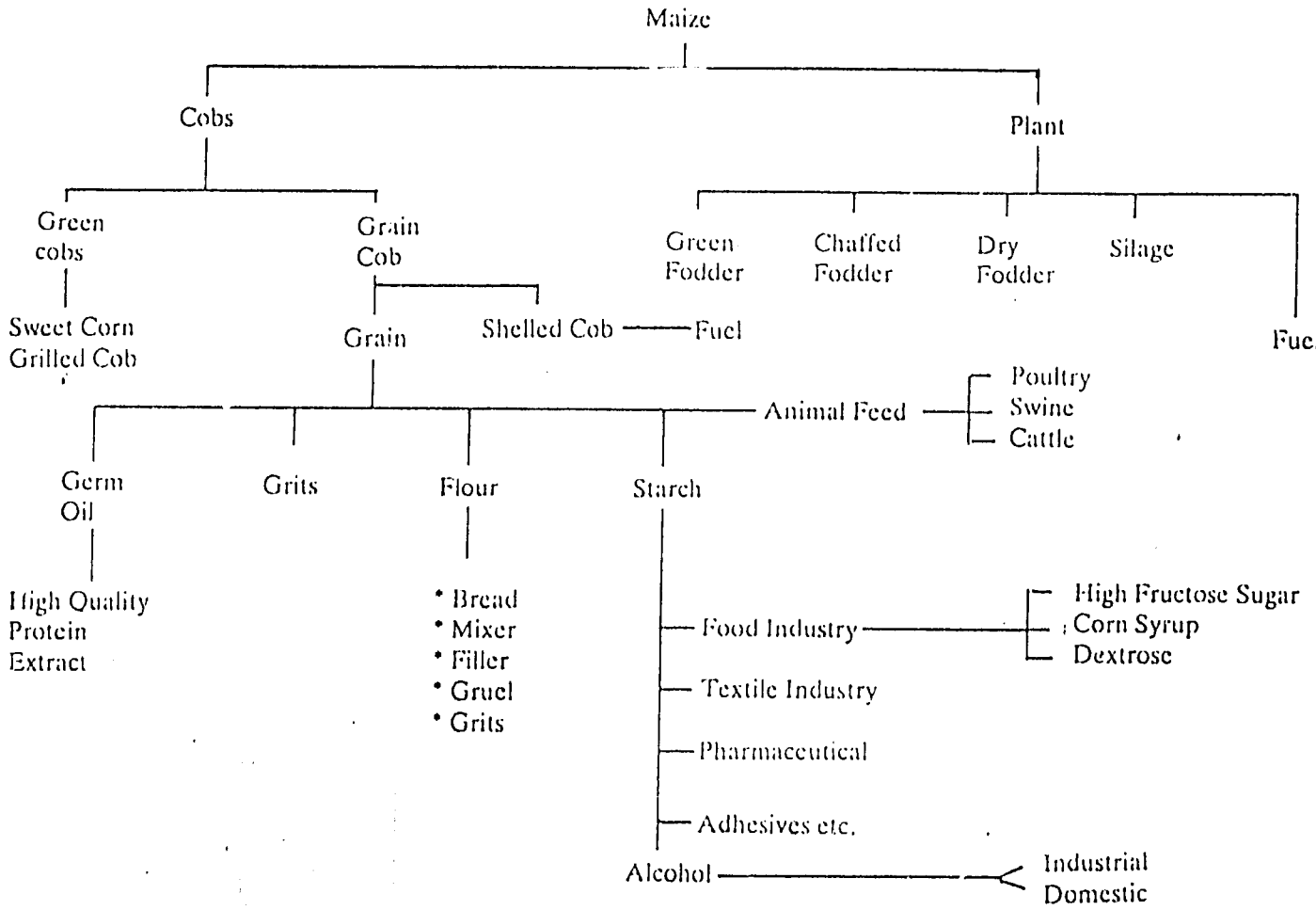

Fig. 3.2. Multiple Uses of Maize (after Kaul, 1985)

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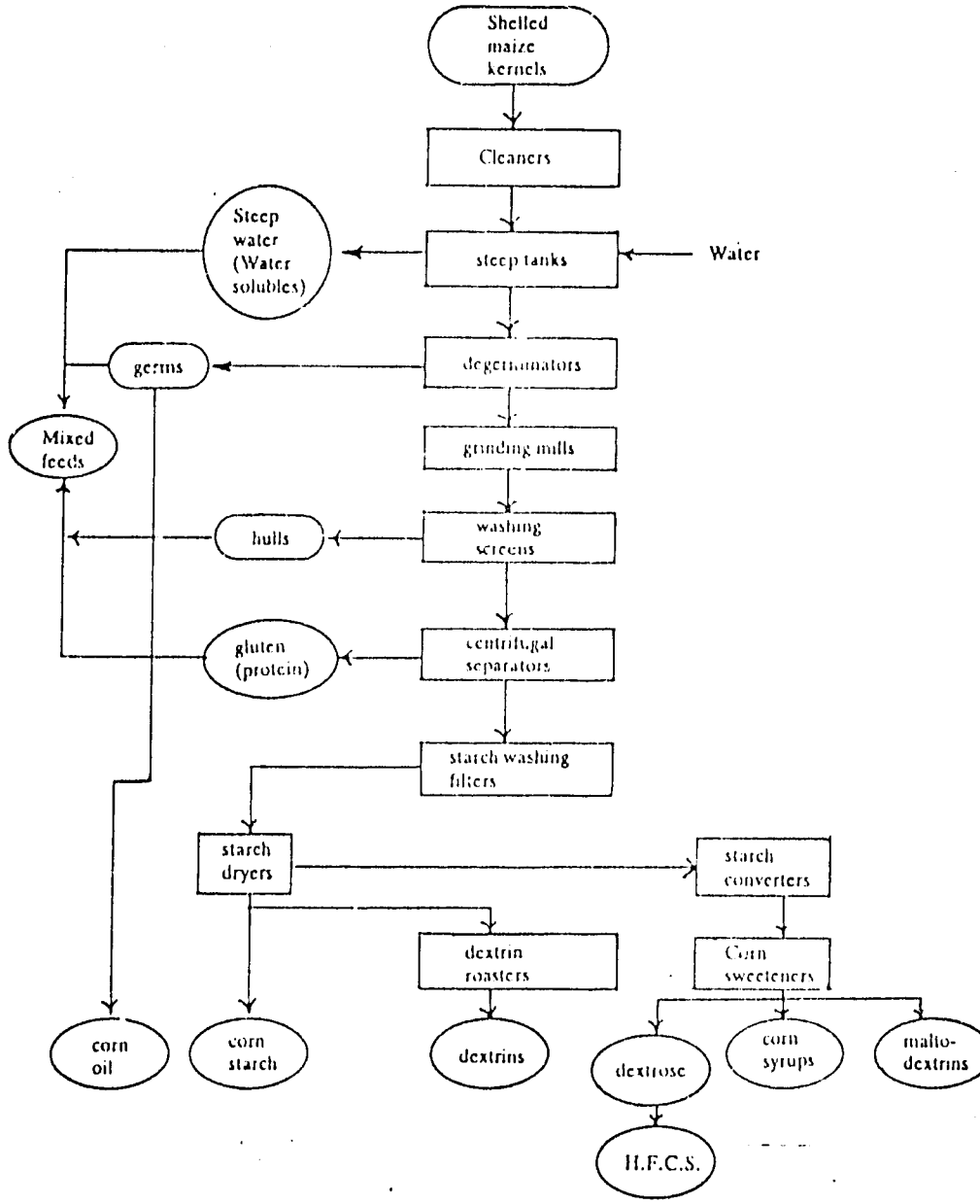

Fig. 3.3. Simplified Flow Sheet of the Maize(corn) Wet Milling Process and the Principal Products (the Products Which are Marketed are Encircled) (after Kaul. 1985).

can prevent human blindness. The chemical compositions of maize grain are presented in Tables 3.6, 3.7 and 3.8.

In 1964 some high lysine maize varieties were identified in USA. These are of particular interest in child feeding and other programs where high lysine content is required to overcome malnourishment. Opaque-2 type maize varieties are now available in the USA which can be imported along with the high carotine types for the specific purpose of utilizing in the vulnerable group feeding programs.

3.4. Export Potential

Some reviewers have recommended that Bangladesh could produce maize primarily, if not exclusively, for export to the importing countries in Asia namely Japan, South Korea, Singapore and Formosa (Efferson, 1983; Hart, 1986). The authors believe that Bangladesh does not have good prospects for exporting maize for the following reasons:

- Global price of maize has lately been erratic and low allowing little, if any, margin of profit for Bangladeshi producers (Table 3.9). Even after accounting for lower freight cost at which Bangladesh could deliver maize to nearby importing countries, it is unlikely that it could compete with the United States, Latin America and Thailand. The cost of production at the farmgate level in Bangladesh is estimated to be around $60 per ton. At least $30 per ton would have to be added for collection, cleaning and transport to the port, leaving no margin for traders and export merchants.

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Table 3.6. Comparative Nutritive Value of Maize, Wheat and Rice Food composition per 100 g of Edible Protein

Composition	Maize Dry	Maize Tender	Wheat flour (whole)	Rice milled
Energy (kcal.)	342.0	125.0	341.0	346.0
Protein (g)	11.1	4.7	12.1	6.4
Fat (g)	3.6	0.9	1.7	0.4
Minerals (g)	1.5	0.8	2.7	0.7
Fibre (g)	2.7	1.9	1.9	0.2
Carbohydrates (g)	66.2	24.6	69.4	79.0
Calcium (mg)	10.0	9.0	48.0	9.0
Phosphorus (mg)	348.0	121.0	355.0	143.0
Iron (mg)	2.0	1.1	11.5	4.0
Carotene (mg)	90.0	32.0	29.0	-
Thiamine (mg)	0.4	0.1	0.5	0.2
Riboflavin (mg)	0.1	0.2	0.2	0.1
Niacin (mg)	1.8	0.6	4.3	3.8
Vitamin C (mg)	0.0	6.0	0.0	0.0
Moisture (g)	14.9	67.1	12.2	13.3

Source : Islam and Kaul, 1986

Table 3.7. Comparative Amino Acid Composition of Maize, Rice, Wheat and Sorghum

Amino acids*	Maize dry	Rice milled	Wheat whole	Sorghum
Total N	1.78	1.02	1.89	1.78
Arginine	0.29	0.64	0.29	0.29
Histidine	0.16	0.19	0.13	0.16
Lysine	0.20	0.22	0.17	0.20
Tryptophan	0.04	0.07	0.07	0.04
Phenylalanine	0.29	0.35	0.28	0.29
Tyrosine	0.24	0.30	0.18	0.24
Methionine	0.12	0.22	0.09	0.12
Cystine	0.10	0.10	0.14	0.10
Threonine	0.28	0.29	0.18	0.28
Leucine	0.72	0.56	0.41	0.72
Isoleucine	0.24	0.31	0.22	0.24
Valine	0.30	0.46	0.28	0.30

Source : Islam and Kaul, 1986

* Only total N expressed as g/100g and the rest as $g\,g^{-1}$ N.

Table 3.8. Comparative Trace Minerals Composition of Maize, Rice, Wheat and Sorghum

Trace minerals (mg/100g)	Maize Dry	Maize Tender	Rice milled	Wheat whole	Sorghum
Magnesium	144.0	40.0	38.0	138.0	140.0
Sodium	15.9	51.7	10.0	17.1	7.5
Potassium	286.0	151.0	117.0	284.0	131.0
Copper	0.2	-	0.3	0.5	1.8
Sulphur	114.0	61.0	79.0	128.0	54.0
Chlorine	33.0	54.0	13.0	47.0	44.0

Source: Islam and Kaul, 1986

Table 3.9. International Prices for Maize, Wheat and Rice (US$ per ton)

Commodity	January 1985	December 1986	August 11987
Maize	106.27	65.11	80.00
Wheat	125.31	101.93	111.50
Rice	230.00	205.00	214.00

Source : Far Eastern Economic Review(s); USAID

- The quality standards acceptable to the international buyers are very stringent and would call for highly organized drying, culling and cleaning operations resulting in capital investment on expensive machines. Moreover, the machines available for these operations are usually suitable for large volumes. Local traders are unlikely to invest on the same in the absence of an already existing assured supply. Bangladesh authorities would

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have to set quality standards for export comparable to Thailand. Moisture and aflatoxin levels would need to be strictly checked.

- To be able to accept Bangladeshi maize on a regular basis the international traders, as well as ultimate buyers, would have to be assured of continued supply. To ascertain the same, maize will have either to be produced in large block farms or cooperatives will need to be set up.

Considering the limitations enumerated above we feel that it would be at least ten years before exportable quantities of maize of good quality can be produced in Bangladesh. Further more, considerable effort on quality control would need to be made in the meanwhile. One way to gain access to the international maize market would be to reduce the production costs and increase the per acre yields, substantially. If a conscious effort is made to produce large quantities of exportable maize, it will have to be produced in the winter season on irrigated, well managed crop land. Winter maize is likely to be harvested at lower moisture content with limited chances of mycotoxin contamination.

3.5. Industrial Use

As mentioned elsewhere, one of the important attributes of maize crop is its versatility of use as a raw material in various industries. Annex 3.4 lists numerous products and byproducts from maize which are used in a number of essential industries. An average food store in the US

carries at least a thousand products to which maize has contributed directly or indirectly. The largest demand is for starch which is used in the manufacture of textile, paper, boards, glue, pharmaceutical products and sugar.

Bangladesh imports 15-20 thousand tons of starch annually (Experience incorporated, 1978, Sami, 1979; Efferson, 1983; Pray, 1981). The same is used in textile and jute industries and in jute carpet backing, paper glazing and safety-match making. In addition, the pharmaceutical industry requires several tons of starch as an extender in tablet making and for the production of glucose. A small quantity is required by the manufacturers of cosmetics. (Table 3.10).

Several attempts have been made to set up starch manufacturing factories in the country. Only one unit is in operation (Rahman Chemicals--personal communication). It uses tubers and roots as raw materials. Cassava and sweet potato are the chief raw materials. Due to their non availability throughout the year and due to various other limitations the factory runs only upto 40 to 60 percent of its capacity. The owners are in the process of diversifying and modernizing their plant but they do not intend to make it suitable for handling maize as a raw material. They do however admit that the same would be possible when maize is available on a regular basis in future. We made a comparison of the

Table 3.10. Estimated Annual Demand for Starch in Bangladesh (1980)

End use	Metric Tons
Textile Mills	1,435
Jute (Carpet backing)	1,346
Paper Mills	779
Hand Looms	6,800
Jute (Hessian)	2,526
Match Industry	752
Laundry	700
Adhesives & Paste	1,000
Pharmaceuticals	58
Converted Products	200
TOTAL	15,590*

* Equivalent to 24,000 tons of maize

Source : Experience Inc. BSFIC 1979.

costs of raw materials and discussed the same with Rahman Chemicals. They did not contest our figures. Yet we could not convince them that an investment on the modification of their plant, to accept maize as a year round reliable raw material, would be cost effective (Table 3.11). Rahman Chemicals is facing considerable challenge from the indenters of starch who have permission from the Government of Bangladesh to import the requisite quantities.

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Table 3.11. Comparison of Raw Material Costs of Starch

Raw materials	Starch %	Price Tk/Kg	Cost on starch basis (Tk/Kg)	By product (Tk/Kg)	Net Cost (Tk/Kg)
Imported Maize	65	5	7.69	2.34	5.35
Local maize	65	7	10.77	3.82	6.95
Broken rice	73	10	13.70	1.46	12.36
Potatoes	16	7	43.75	0	43.75
Sweet potatoes	22	4	18.18	0	18.18
Tamarind seeds	50	20	40.00	0	40.00

Having considered the lag period between now and the time when assured quantities of maize can be spared for the manufacturing industries, and based on our evaluation of the status of indigenous starch industry, we conclude that the need of maize for this sector need not be taken into consideration in making any projections for the coming five years. It may, however, be added that as much as 15,000 tons of dry maize grain could ultimately be utilized by the starch industry.

Should the maize production attain the projected targets in the 1990s, it should be feasible at that stage to consider setting up of a wet-milling plant in the country. This plant would have the capacity to produce numerous byproducts including cholesterol free poly-unsaturated edible oil, high-fructose sugar and high protein concentrate (Figure 3.3). Wet-milling plants are not yet operational in too many developing countries. A pilot plant imported from Japan by Bangladesh in 1982 is yet to be installed. We propose that funds be made available to commission the same for research purposes if it is not already damaged beyond repair. The most appropriate organization to look into this matter is Bangladesh Council for Scientific and Industrial Research (BCSIR).

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4. INTRODUCTION OF MAIZE UNDER PL-480, TITLE III PROGRAM

4. INTRODUCTION OF MAIZE UNDER PL-480 TITLE III PROGRAM

Bangladesh is uniquely placed to undertake an innovative action under its food aid program. It has the long experience of food assistance based on wheat, a commodity that was nearly unknown 15 years ago. Today the same constitutes more than 95% of all the food aid received. Over the last few years, the public foodgrain distribution system is under review and is likely to be restructured (Beacon consultancy report, 1986). Introduction of maize as a component of food aid in the coming decade would not only be feasible but desirable to help introduce this versatile cereal in the diet and the crop in the farming systems of Bangladesh. In fact, more than helping alleviate the problem of food deficiency, a modest increment of maize in the PL-480 introduced grain will set the scene for the cultivation of this crop in areas and under conditions where rice and wheat are giving poor returns to the farmers. The various issues pertaining to import of maize under PL-480 are discussed.

4.1. Acceptability

Traditionally, Bangladesh has been a rice consuming country. After the 1974 famine, food habits have been changed to a great extent by incorporating wheat and potato in the diet. Wheat, the neglected crop of early sixties, has now become the second staple food crop in the country. In fact, wheat has stabilized food availability to a considerable extent. Bulk of the food aid is in the form of wheat which is now accepted well as a major meal by all strata of the society. The urban elite eat it by choice in place of rice, at least occasionally, as one major meal.

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Potential of maize as a significant component of diet would of course depend on its acceptance as a staple food. Like wheat in the sixties, maize is often perceived as poor man's food. The only forms in which it is very popular are roasted cobs, khai (puffed maize) and pop corn. The people of Bihari origin, who number about 500,000 eat it in the form of flour with or without mixing with wheat. Our interviews with some representatives of the Biharis revealed that if maize was available in adequate quantities they would consume it by preference, over rice.

Other distinct cultural groups which consume maize as one of the staples consist of the tribal populations of Bandarban, Chittagong Hill Tracts, Chittagong, Jamalpur, Mymensingh and Tangail. Altogether their population exceeds 550,000. These people consume maize in the boiled form.

It therefore appears that there is already more than one percent of Bangladesh's population who would not require any persuation to consume maize. However, promoting maize as the third cereal crop of Bangladesh would require introducing it to the population at large through gradual seduction and persuation. In the self targeting class of rural poor, substitution of 25 percent of wheat flour would go nearly unnoticed and would be acceptable. If a larger quantity of maize is given in place of wheat for the same amount of work in the FFWP and canal digging, it is likely to be accepted in the form of cracked grain which people could eat as Khichari. Similarly, if sold at a lower price than wheat in the modified rationing system, there will be considerable offtake. These suggestions however need to be verified through well conducted pilot studies on acceptability.

not necessarily

Agricultural Sector Team of Canada conducted a survey to determine the demand for, and attitude of consumers towards, maize and its products. Their findings are summarised:

- Green roasted cobs were by far the most preferred form of maize followed by pop-corn and fried grains. Flour was consumed by 8 percent of the sample population. They reported that Pray et al. (1981) had got similar results in their survey. Pitha(cake) and Khichuri prepared with pulses were also eaten.

- Forty five percent of the respondents reported increase in the consumption of maize in the past 10-15 years. Sixty one percent of those who reported a decrease in the consumption ascribed the same to the lack of availability of maize.

- While green cobs are consumed mostly as a snack, grain and flour form part of a regular meal (lunch and dinner).

Tables 4.1 to 4.2 reproduced from the AST report (Mohammad, 1985) are self explanatory.

It may be concluded that maize is already known to the Bangladeshi food consumers, at least as a snack or breakfast food. About one million of the population are culturally adapted to using maize as a staple. At relatively lower prices than wheat, it should be acceptable to consumers who obtain their food through the modified rationing system. Finally, given larger quantities than wheat per unit of work performed it can be targeted on some 2.5 million beneficiaries of the Food for Work Programs. Altogether maize can be directly brought into the diets of some 3-4 percent of the Bangladeshi population. This does not include indirect use of

maize through poultry and livestock industry. Ultimate acceptance of maize by the population at large would of course depend upon the promotional endeavours. This aspect is discussed separately.

Table 4.1. Reasons for Decreased Consumption of Maize and Maize Products (percent)

	Dislike	Unavailability	Increased prices	Others	Total
Green cobs	14	63	16	7	100
Grains	-	66	34	-	100
Flour	-	55	45	-	100
Others	-	33	67	-	100
All	11	61	22	6	100

Rounded.

Source: AST Survey, 1984

Table 4.2. Maize Considered as a Cereal/Third Cereal Crop by Income Group (percent)

Income group (per month)	Cereal crops			Third cereal crops		
	Yes	No	Total	Yes	No	Total
Less than Tk 1000	91	11	100.0	86	14	100.0
Tk 1000-2500	82	18	100.0	83	17	100.0
Over Tk 2500	87	13	100.0	84	16	100.0

Rounded.

Source: AST Surveys, 1984

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4.2. Form

Once the decision is made to import large quantities of maize, under the PL-480 Title III program it will need to be determined as to what form(s) it can be imported. Figure 4.1 depicts a suggested flow-chart prepared on the basis of a number of considerations:

- keeping quality of the ingredients under consideration,
- consumers' preferences,
- expected lag time in offtake,
- storage capabilities, and
- preferences of the end users.

Bangladesh's climate requires that the grain be of flint nature so that the damage due to humidity is minimum. Even flint grain can not be stored for a prolonged period at higher than 14.5 percent moisture. It will otherwise become moldy. The germ of maize is rich in protein and lipids. When acted upon by inherent enzymes proteolitic and lipaze activities set-in leading to rancidity and deterioration of taste and other organolaptic properties. Therefore, degermed (cracked) grain is preferable over flour or grits. This is particuarly valid if the dent varieties of grain are imported. It should be pointed out that dent corn is more likely to be available for export from the US rather than the flint type.

As depicted in Figure 4.1 out of the 10,000 thousand tons of proposed import of maize under PL-480 in 1988 and 1989, 1,000-1,500 tons are recommended to be brought in the form of flour or grits of dent origin for immediate distribution. There should be no difficulty in getting this

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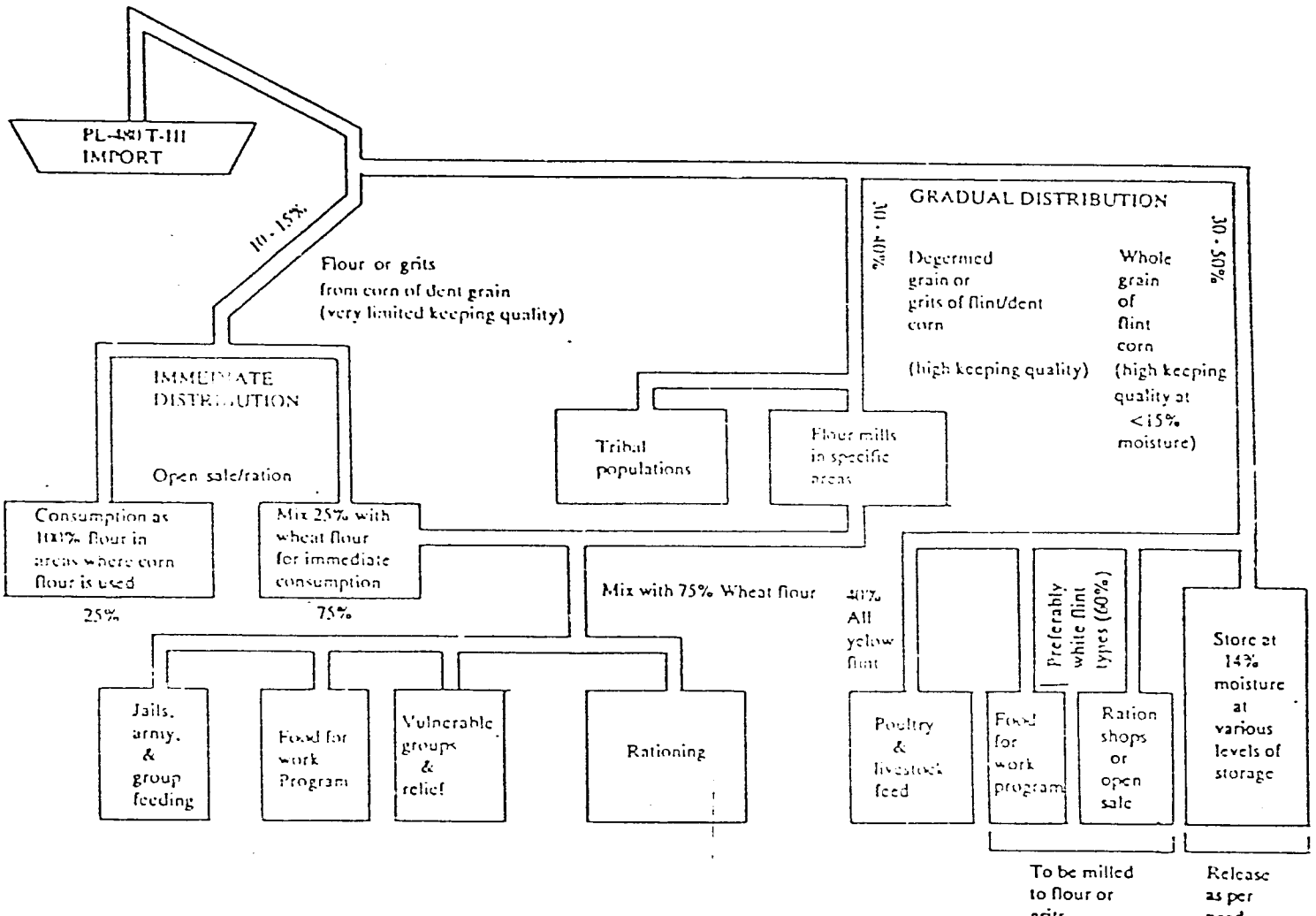

Fig.4.1. Movement of the Various Forms of Imported Maize under Title -III program

small quantity rapidly to the end users. Flour would be targeted directly on Bihari population living in camps in Dhaka and Mymensingh areas and for direct sale to them in Saidpur and adjoining areas.

Thirty to forty percent i.e. 3-4 thousand tons could be shipped into Bangladesh in the form of degermed grains or grits of either flint or dent types. A part of this form of grain will go directly to the tribal populations and a part to the flour mills for conversion into flour for mixing in a 1:3 ratio with wheat flour. As already mentioned, it is this form i.e. mixture with wheat flour which is likely to be the most effective way of introducing maize.

The remaining part of the 10,000 tons would need to be brought as full grain. This maize should preferably be all of the flint nature and yellow in colour since a major proportion of it would be sold to poultry farmers who have special preference for yellow flint types. If stored at 14-15 percent moisture, full grain maize can be gradully released without much loss in its quality. This would however be conditioned by the quality and moisture content of grain at the time of its export and the keeping qality of the container ship.

As already discussed, under the section on acceptablity, more grain would be released to consumers in the form of flour than grits or cracked grain.

4.3. Quantity

Based on our discussions with the various authorities and in considerations of the acceptance and other relevant issues, a phased plan for import and distribution has been drawn. These projections could be

considered to be conservative, particularly in comparison to the optimistic projections made by AST for the prospect of maize in the nineties. Our estimates have taken into consideration a number of factors particularly the pattern of food distribution under PFDS, the projected requirements of the poultry industry and above all, the expectation that the imports will serve bigger purpose of popularising maize in Bangladesh leading to food self sufficiently rather than filling the food gap by itself. The projections are presented in Tables 4.3, 4.4 and graphically represented in Figures 4.2 and 4.3.

Table 4.3 gives phased import of maize from 1988 to 1999 along with a projection of gradual increase in local production. As shown in this Table and Figure 4.2 the import will equal local production by the year 1991. The recommended import will be 10,000 tons each in the years 1988 and 1989, and 20,000 tons in 1990 and 1991. Then on, the quantity will gradually rise upto 50,000 tons by 1997 and continue to be the same for three consecutive years. However, the absolute quantities could increase if the demand and/or acceptability increase through promotion.

Table 4.4. gives the breakdown of the utilization of maize of imported and local origin. The proportional changes over the ten year period are shown. In the year 1988 a projection of 7 million tons is proposed for direct human consumption. The relative percentages of quantities, to be disposed through the various channels of distribution, are listed. Food for Work (FFW) and Vulnerable Group Feeding (VGF) Programs, together will account for an offtake of over 50 percent of this quantity. The Joint Secretary of the Ministry of Agriculture recommended that initially only 5,000 tons of maize be imported. We consider this quantity to be too small.

Table 4.3. Volume and Value of Annual import and Local Production of Maize in Bangladesh (based on recommendations)

Year	Recommended Import		Local Production		Investment on Research Extension and promotion ('000 $)
	(T. Tons)	Value (million $) @ Today price	(T. Tons)	Value(million $)@ todays price	
1988	10	1.70	5	0.85	894
1989	10	1.70	8	1.36	764
1990	20	3.40	12	2.04	674
1991	20	3.40	20	3.40	564
1992	25	4.25	30	5.10	514
1993	30	5.10	45	7.65	
1994	35	5.95	50	8.50	
1995	45	7.65	55	9.35	
1996	45	7.65	55	9.35	
1997	50	8.50	55	9.35	
1998	50	8.50	60	10.20	
1999	50	8.50	65	11.05	3400 (Total 5 years)

Table 4.4. Source and Utilization of Maize at Five-Yearly Intervals (1988-98)

Source/ Utilization	Quantity in Thousand Tons			X Change over 10 years
	1988	1993	1998	
Source:	(15)	(75)	(110)	7X
Import	10	30	50	5X
Local	5	45	60	12X
Utilization:				
1. Human food (Total)	* 7 (47%)	50(66%)	75(68%)	11X
Open sale	** 1.05(15%)	15.0(30%)	30 (40%)	30X
Rationing	1.75(35%)	10.0(20%)	15.0(20%)	8X
F.F.W.P.	2.80(40%)	20.0(40%)	15.0(20%)	5X
V.G.F.P.	0.70(10%)	2.5 (5%)	11.25(15%)	16X
Special uses	0.70	2.5 (5%)	3.75(5%)	5X
2. Poultry Feed	(4)	(8)	(15)	3X
From Import	3	2	0	-4X
From Local	1	6	15	15X
3. Livestock Feed (from local)	2	8	10	5X
4. Fodder Seed	0.5	1	1	2X
5. Industry	0	4	4	4X
6. Wastage and other uses	0.5	4	5	10X

* Percentages in parantheses refer to total available grain.

** Percentages refer to part of the grain allocated for each category of offtake of grain. (For details refer to text).

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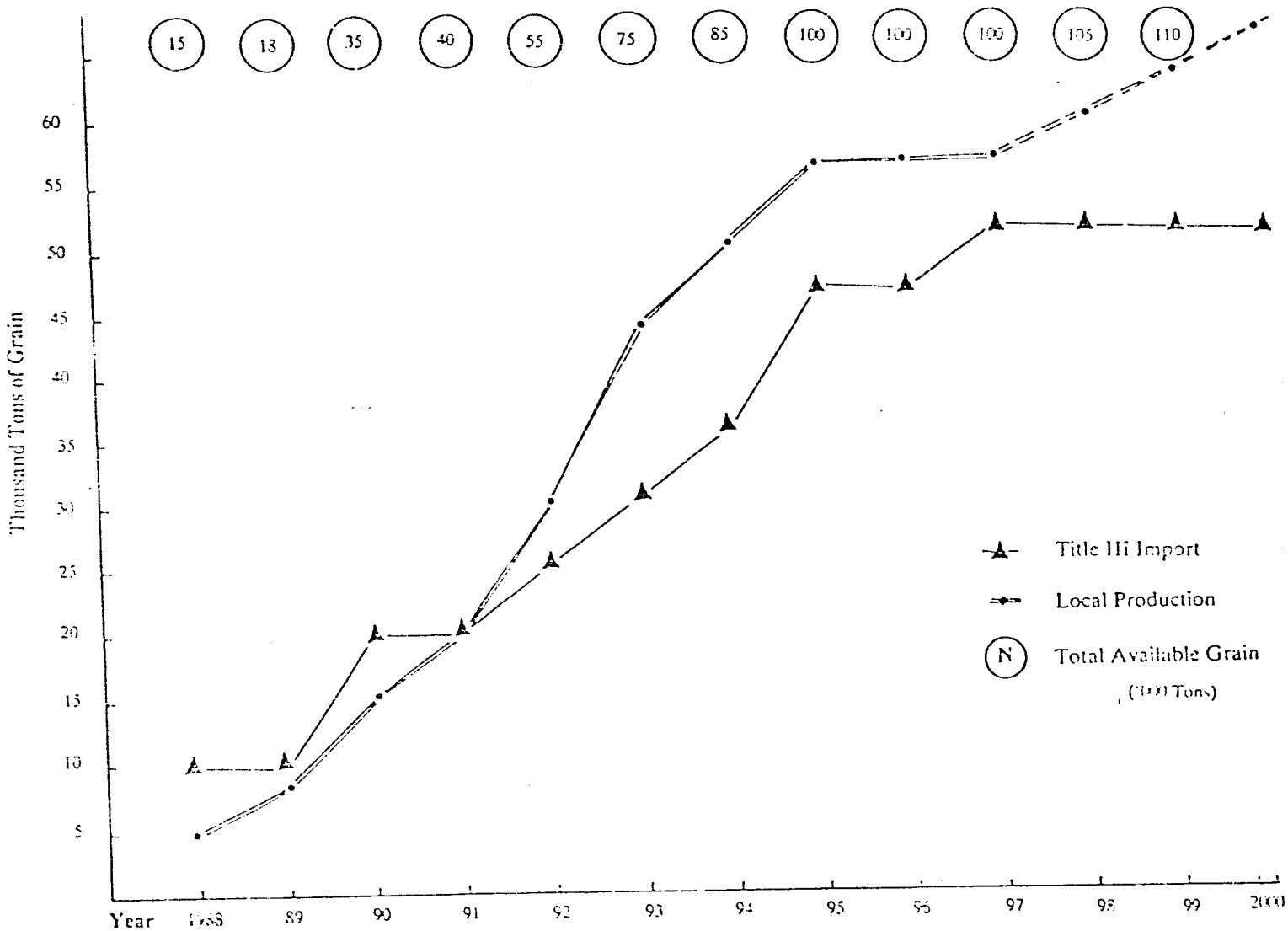

Fig.4.2. Trends in Recommended Import (Title III) and Expected Local Production of Maize in Bangladesh (Assuming that Full Package Program

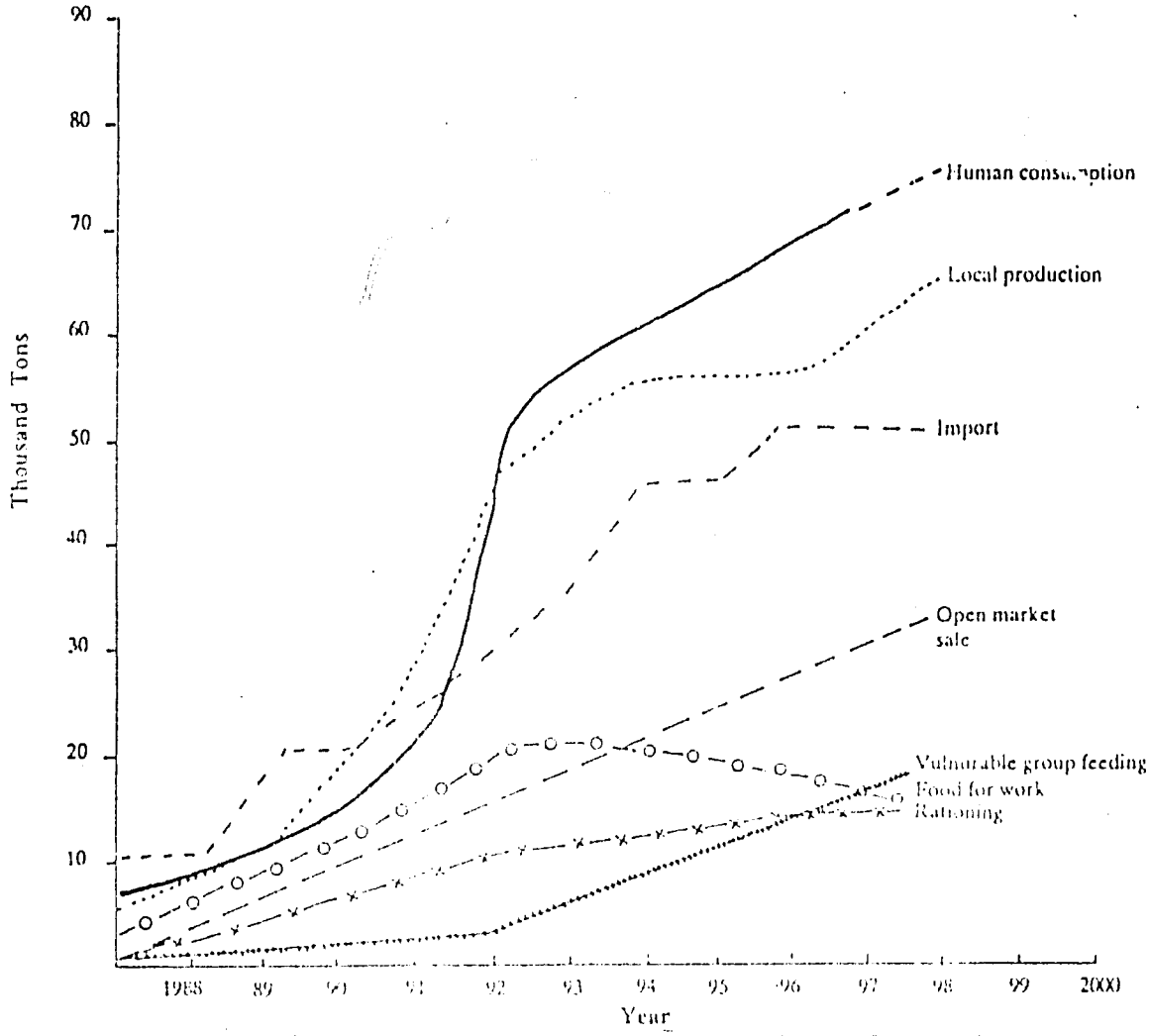

Fig. 4.5. Recommended Trends in Maize Production and Consumption

Poultry feed industry, including egg and broiler enterprises, under the private as well as public sectors, has demonstrated a definite demand of 5-8 thousand tons of maize. Therefore, allocation of 5,000 tons in 1988 is a fair estimate. Similarly, livestock industry in the public sector could use at least 2 thousand tons of maize if the same was available. However, we did not allocate imported maize for the livestock (cattle) sector in view of the limited and unreliable estimates available to us. We suggest that a small feasibility study be conducted on the demand in this sector.

As shown in the Table 4.4 no demand for maize is anticipated from starch or other industries in 1988. [We do not support the claims that a possible demand for maize in immediate future by any industry in Bangladesh.] We do not agree with the reports that a reliable demand exists for maize to be used in the industrial sector, in immediate future. In fact our projections of 4 thousand tons shown in Table 4.4 for the year 1993 are to be taken with caution.

4.4. Price

To fix the consumers' price for maize is a delicate issue. It would affect the farm gate price if and when the maize is produced on a large scale. More important is the psychological effect of its price on the consumers' acceptance. If the price of maize is set too close to wheat or coarse rice, it may not be lifted. Should the price be set significantly lower, the consumer might consider it to be an inferior commodity and again reject it. It is difficult for the authors at this moment of time to make firm recommendations on the consumer price since the grain market is highly

volatile due to possible flood damage to the rice crop. We can only make a general recommendation that whole grain and maize flour prices may be set at 15 percent lower than the corresponding price of wheat and its flour.

In the long run it will be necessary to conduct a study on the response of consumers, as well as producers, to changes in the prices of maize comapred to other grains. It may be added here that in the early eighties the international prices of maize, wheat and milled rice were in the ratio 1:2:3. The latest ratio is 0.8:1.1:2.1.

4.5. Targeting

As already mentioned the most appropriate consumers of maize, in the initial stages of its introduction, would be the 500,000 Biharis, 500,000 tribals and about 2.5 million rural landless and disadvantaged groups covered under the FFWP and VGFP. In addition, it would be easy to supply the maize to the jails, orphanages, destitute homes, child care centers and perhaps to Police, Ansars and defence forces. The potential recipients to be covered under the above mentioned categories will be fairly large to absorb the 7,000 tons of maize proposed in the first phase (1988 and 1989). In the second phase other potential consumers, particularly in the urban areas, can be reached through the open market sale and distribution through statutory and modified rationing. Other possible consumers are small and large bakeries. The authors did explore the possibilities of using maize as a raw material for the production of sophisticated breakfast foods. It was found that there are no appropriate breakfast food makers existing in

the country who could use maize at this stage. Perhaps in another five years, when maize has established itself well, there would be scope for such expansion.

We recommend that the following specific geographic areas be taken up for the introduction of maize as food in the first phase:

- Dhaka metropolitan and Mymensingh areas: The target population would be some selected Bihari camps to which maize would be given through Vulnerable Group Feeding, Open Market Sales or a special rationing program. Small quantities may given to orphanages, destitute homes and for relief work.
- Saidpur urban area: Maize flour alone and mixed with wheat flour may be sold through the Open Market Sales Program or, possibly, a special rationing operation.
- Chittagong Hilly areas, Madhupur, Tangail and Jamalpur: Grits, cracked and whole grains to be dispensed through ration shops and Food for Work Program aimed at tribal population.
- Nilphamari, Rangpur, Dinajpur, Thakurgaon, Kushtia and Jessore: A few major Food for Work program areas may be selected for initial pilot studies. In this case, substitution of one-fourth wheat with maize may be attempted. Alternately, in comparison to wheat, larger quantities of whole grain maize grits or maize flour may be distributed in place of wheat.

4.6. Preparations

Maize can be eaten in hundreds of different ways. Starting with green boiled cobs to highly sophisticated breakfast foods can be prepared out of maize. A list of some 30 preparations adaptable in Bangladesh is

reproduced in the Annex 4.1 (Islam and Kaul, 1986). All the preparations listed there were test cooked by the wives of the authors of the original monograph. It should be easy to popularise the same.

As mentioned earlier, different communities may prefer to eat maize in different ways. Also different types of preparations would require additional ingredients of varying costs. Once again, maize has the versatility to be cooked with nearly no additional costs to preparations. The poorer targeted consumers of Bangladesh who would be given maize in the initial stages are most likely to eat it in the form of Shatu, Khichuri, Rooti, Pitha and locally produced biscuits. All these preparations are easy to make and do not require any overhead expenses.

4.7. Promotion

Most of the potential maize consumers interviewed by us mentioned that supply should be matched by intense promotional campaigns to dispel the following wrong notions:

- Maize is used only for livestock consumption in the western countries and is not fit for human consumption.
- Maize is poor man's food, to be eaten only as a last resort.
- Maize is not as nutritious as other cereals and its digestibility is poorer, especially for the children.
- Maize can not be eaten for lunch and dinner as a main meal.

The authors recommend a well funded sustained campaign to be launched before maize is introduced in the consumer market. This campaign should be professionally designed, based on careful market responses. All possible media including newspapers, journals, radio, television and films

should be mobilized simultaneously and the campaign should be continued unabated for several months in a row. Along with this familiarization campaign, home science graduates should be employed to demonstrate simple but attractive preparations of maize at Zila and Upazila levels. A national maize promotion committee, with branches at Zila and Upazila levels, should hold practical demonstration to popularize maize dishes. The female extension agents in the department of Agricultural Extension may be requested to assist in the campaign. Again through these agents small packets of maize seeds could be made available to all the primary and high schools in the rural areas to familiarize them with the maize plant. Even in the urban elite class maize dishes could be introduced through food fairs and other means. The goal would be to introduce maize at all possible levels through a sustained campaign. In the tentative budget suggested to strengthen the national maize consumption and production program, a sum of US$250,000 has been allocated for a five year period (refer to Chapter 5).

4.8. Processing Requirements

Since it is not advisable to import maize in the form of flour for reasons of limited keeping quality of the same, it is necessary to consider the processing requirements of imported maize. One possibility discussed by several authors, and recommended to us during personal interviews, is to set up a central flour mill in private sector at Chittagong with subsequent scope of adding the wet milling process to the same. We do not recommend the wet milling process in the early stages of maize introduction and production due to uncertainties associated with the scope and rate of expansion of maize. Secondly, wet milling technology is fairly complex and

is not yet popular in too many developing countries. If the grain can not be imported in degermed or cracked state, it may be advisable to set up a simple degerming plant in Chittagong. This plant, with a capacity of 5 tons a day, would beocme self supportive since it will yield two valuable by-products namely maize oil and CMP (concentrated maize protein). The latter product could be used as concentrated poultry feed or as a raw material for the baby food preparation with further purifications. Other less expensive apporach is to distribute maize through existing flour mills and through mechanized diesel/electric powered Chakkis. These are already operating in the well developed Upazilas and are currently used for wheat milling. The only catch in adopting this route is the possible delays that might occur between import and distribution, leading to deterioration of grain quality during storage and transit.

All the intact or cracked grain, that might be distributed through the FFWP and the ration shops, is likely to be ground with hand Chakkis into grits or to be hand pounded in Dhekis. The tribal consumers are likely to prefer this option while Bihari population would prefer getting the grain milled in smaller backyard motorized Chakkis. For the consumption by other communities, using maize as one-fourth ingredient of wheat flour, centralized mills described above, are recommended. It may be added here that existing wheat flour mills can be used for the milling of maize without any modification.

4.9. Quality

Some aspects of quality requirements of imported maize have already been disucssed in the section on acceptability. The following attributes are important:

- moisture content below 15 percent,
- flint, not dent, structure of grain,
- least infestation with weevils and other storage pests,
- no aflatoxin contamination,
- no rancidity or uric-acid,
- least infestation with extragenous seeds of weeds and other grains, and
- freedom from rat and mice damage.

Most important of the above mentioned requirements is the flint grain structure which is desired in the tropical areas for longer shelf life. Control of moisture content below 15% will take care of most of the post harvest losses ascribed to microbes and enzyme activity.

To be able to mix the maize flour with wheat flour, the texture and particle size is of consequence. Too large a particle size will not be preferred. From the nutritional point of view, it is better to have yellow coloured endosperm since it would have adequate carotene content per 200 g serving to meet the consumers' vitamin A requirement. Some consumers may however prefer white colour, particularly if it is slightly sweetish in taste. Grits of dent-corn origin and cracked dent corn will be preferred by the consumers who might make Shatu (fried crushed grain) or eat boiled preparations akin to rice. Tribal populations of Chittagong Hill Tracts and Madhupur are likely to prefer this form of grain. To avoid the adulteration of wheat with maize flour, yellow coloured maize would be better.

5. COMPEHENSIVE ACTION PLAN FOR RESEARCH AND DEVELOPMENT

5. COMPREHENSIVE ACTION PLAN FOR RESEARCH AND DEVELOPMENT

5.1. Overview

A careful review of the existing status of maize production and research in Bangladesh and an assessment of the prospects of this crop have led us to recommend a strategy for R & D. The salient features of the same are given.

- Sale proceeds of maize imported under PL-480 Title III in the first two years will finance the program for 5 years. The imports may be raised from 10,000 tons in 1988 to 50,000 tons in 1999. Simultaneous yet steeper increase in local production, from 5,000 tons in 1988 to 65,000 tons in 1999, should be aimed at. This would be possible only if the proposed research program is in place.

- Simultaneous investment on a crash program on the promotion of maize would need to be made.

- Modest quantities of seed will need to be imported in the beginning of the program until local research and seed production programs get off the gound.

- Investment should be made on the services and credit for at least five years in the selected areas of maize production.

- The procurement and consumer prices of maize should be set at least 10-15 percent below wheat. Actual prices should be determined upon careful analyses of demand and supply, which may be reviewed periodically.

- The investment on research, development and promotion could roughly be made in the following proportions:

Investment	Percentage
Research & Coordination	30
Promotion	10
Seed & Seed Production	30
Extension, Training & Technical Assistance	20
Credit & Services	10
Total	100

- Relevant surveys, pilot studies and research on important issues should be conducted in a systematic manner. Some of the issues are identified in Table 5.1. Annex 5.1 lists recommendations made at the Workshop on maize held at BARI in March 1985. The same are still valid.

Table 5.1. Further Studies Recommended on Maize Consumption, Distribution and Production

No.	Study	Subject	Nature and Priority	Time Required (months)	Institution
I	CONSUMPTION				
	a) Forms in which maize is consumed in Chittagong Hill Tracts and by Biharis	Food Monitoring & Home Science	Basic, 1988	3	Ministry of Food, Institute of Home Economics, Institute of Nutrition
	b) Innovative studies on the use of maize grits and flour in local food preparation	Home Science	Applied 1988	12	Institute of Home Economics
II	DISTRIBUTION				
	a) Farm-gate and consumers' price studies on maize and its marketing	Economics	Surveys 1989	6	Directorate of Agricultural Marketing and Food Monitoring Unit
	b) Feasibility study on the self-targeting of maize	Economics	Survey 1988	3	Directorate of Agricultural Marketing and Food Monitoring Unit
	c) Maize in Child Feeding Programs	Socio-economics	Applied 1989	6	Institutue of Nutrition
III	PRODUCTION				
	a) Preparation of a work plan for breeding, agronomy, post-harvest and other research	Agriculture	Planning 1988	3	BARI
	b) Workplan for Seed Production	Agriculture	Planning 1989	3	BADC & BARI
	c) Cost-benefit studies	Agr.Economics	Survey 1988	4	BARI

Priorities and details for these and/or other studies will be determined by relevant institutes when the project gets on its way.

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The projections used in this study would appear to be highly conservative in comparison to the ones made earlier by Islam and Kaul (1986) and by the AST (Mo'ammad, 1985). Our estimates may be termed to be "achievable" while the earlier estimates could be called "desirable". Existing market opportunities, scope of distribution of grains and the existing research and extension preparedness have all been taken into consideration in setting these goals. The basic theme is to gradually increase the imports while simultaneously increasing the local production, using the sale proceeds of the two initial years of import to support a five-year R & D program. It is our expectation that the local production as well as import may exceed our projections. We however hope that, given necessary policy support, the promotion and extension would not let our projections fall any lower. In any case, the level of effort, investment on R & D and the size of the program may be determined after a thorough review of our recommendations is made. At this stage our recommendations may be treated only as a guideline for further discussions.

The tentative budget outline presented in Table 5.2 is based on the assumption that sale proceeds of 20,000 tons of maize imported in 1988 and 1989 will be ploughed back into research, development, extension, promotion and service components of an integrated maize development project. It has been assumed that maize can be sold at least at $170 per ton (roughly Taka 200 per maund) in the local market, yielding $3,400,000 for 20,000 tons.

Eighteen line items have been identified for investment in the support of a national maize production and consumption program. Table 5.2 is self explanatory.

Table 5.2: [illegible] to Strengthen the National Maize Consumption [illegible] Prod[illegible] Program in Bangladesh (5 years; '000 $)

No.	Area	Institute	Y1	2	3	4	5	Total	%
1	Coordinator's office	Min. of Food	50	25	20	10	10	115	3.4
2	Promotion	Min. of Food	50	50	20	20	20	160	4.7
3	Home Science	D U	80	20	20	10	20	150	4.4
4	Socio Economics	BARC	40	--	20	10	20	90	2.6
5	Breeding	BARI	100	40	40	40	40	260	7.7
6	Agronomy	BARI	60	20	20	20	20	140	4.1
7	On-farm	BARI	20	20	20	20	30	110	3.2
8	Ag. Extension	DAE	80	80	30	30	30	250	7.5
9	Pest Management	BARI	10	10	20	20	20	80	2.5
10	FSR	BARC	20	20	20	20	20	100	2.9
11	Pilot Plant Operation	BAU	10	4	4	4	4	26	0.8
12	Poultry Nutrition	BAU	30	15	20	--	--	65	2.0
13	Fodder Research	BARI	30	30	20	10	10	100	2.9
14	Tech. Assistance	BARC	40	80	40	20	40	220	6.5
15	Training (Local & Overseas)	BARC/DAE O L	20 20	30 20	20 30	10 20	10 20	200	5.8
16	Credit	DAE	34	50	50	50	50	234	6.9
17	Purchase of Seed (Import)	BADC	100	200	200	200	100	800	23.3
18	Production of Seed (Local)	BADC	100	50	50	50	50	300	8.7
	Total		894	764	664	564	514	3400	--
	%		26.3	22.5	19.5	16.6	15.1		100

Since the proposed R and D program would involve several institutions, falling under five different Ministries, it is obvious that a project co-ordinating body would need to be formed. The same could be done either by expanding the existing task force on maize, appointed in 1985 by the Ministry of Agriculture, or by forming a fresh committee with the Ministry of Food as the Co-ordinating authority. The committee should have full authority to make key decisions and to give directives to the various agencies involved in R & D. A coordinators office, to deal exclusively with the promotion of maize, may be set up. This office would in turn cooridnate the entire program and support all research and development activities under the same. Requisite funds may be released periodically as per schedule drawn in advance. Annual budgets for the individual areas of activity would have to be drawn when action plan becomes operational. The success of this co-ordinated program would depend on the degree of coordination provided by the coordinator's office and cooperation provided by the constituent institutes in return. The weakest link would become the first limiting factor. Fig. 5.1 and Fig. 5.2 depict the essential components of the proposed action plan. The need for effective coordination and linkages amongst the institutions becomes clear when roles of relevant organizations are well understood.

The distribution pattern of maize is already discussed in chapters 4 and 5 should be read together to complete the picture of a comprehensive plan recommended by us.

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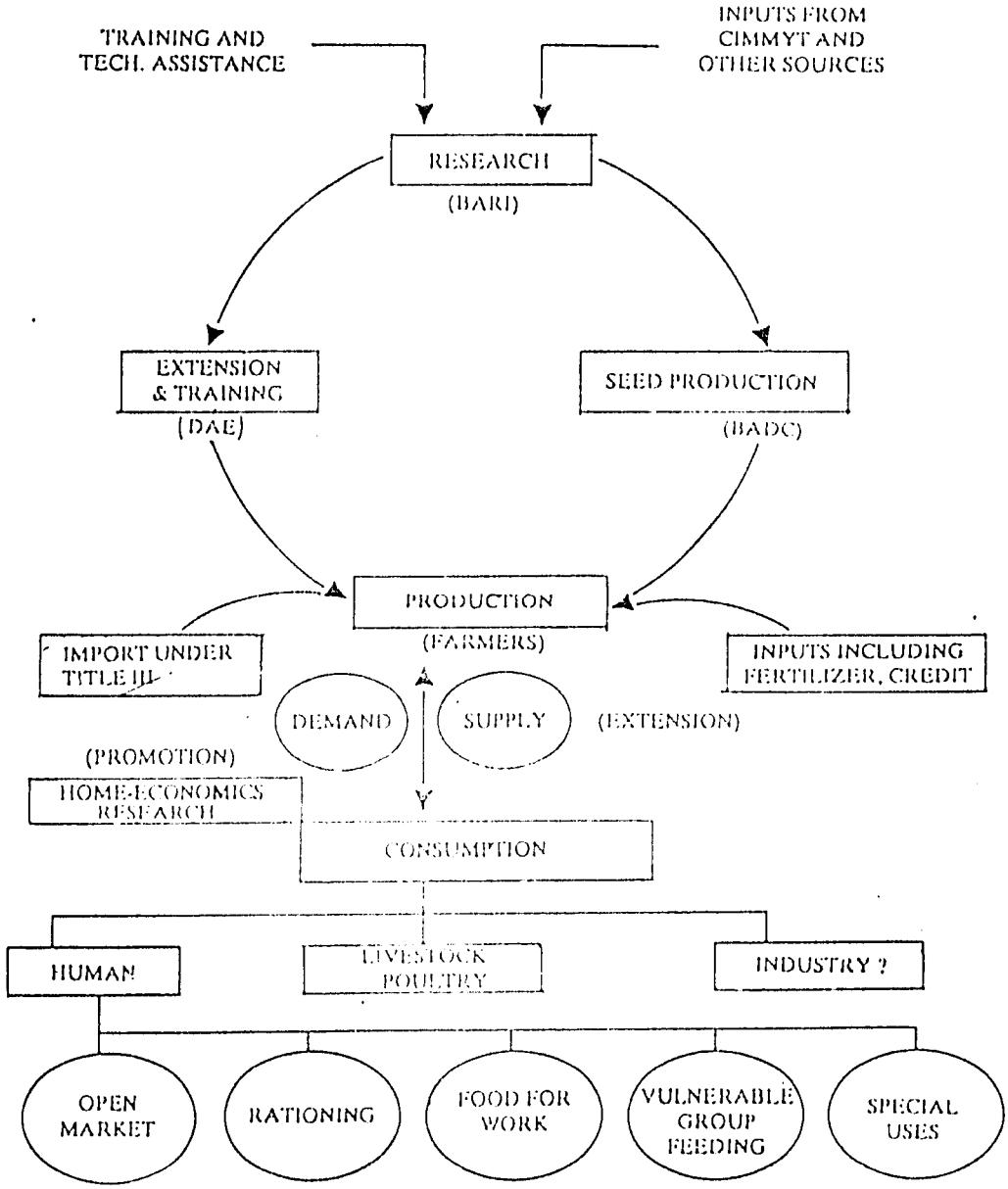

Fig. 5.1. Major Components of a Maize Production and Utilization Program

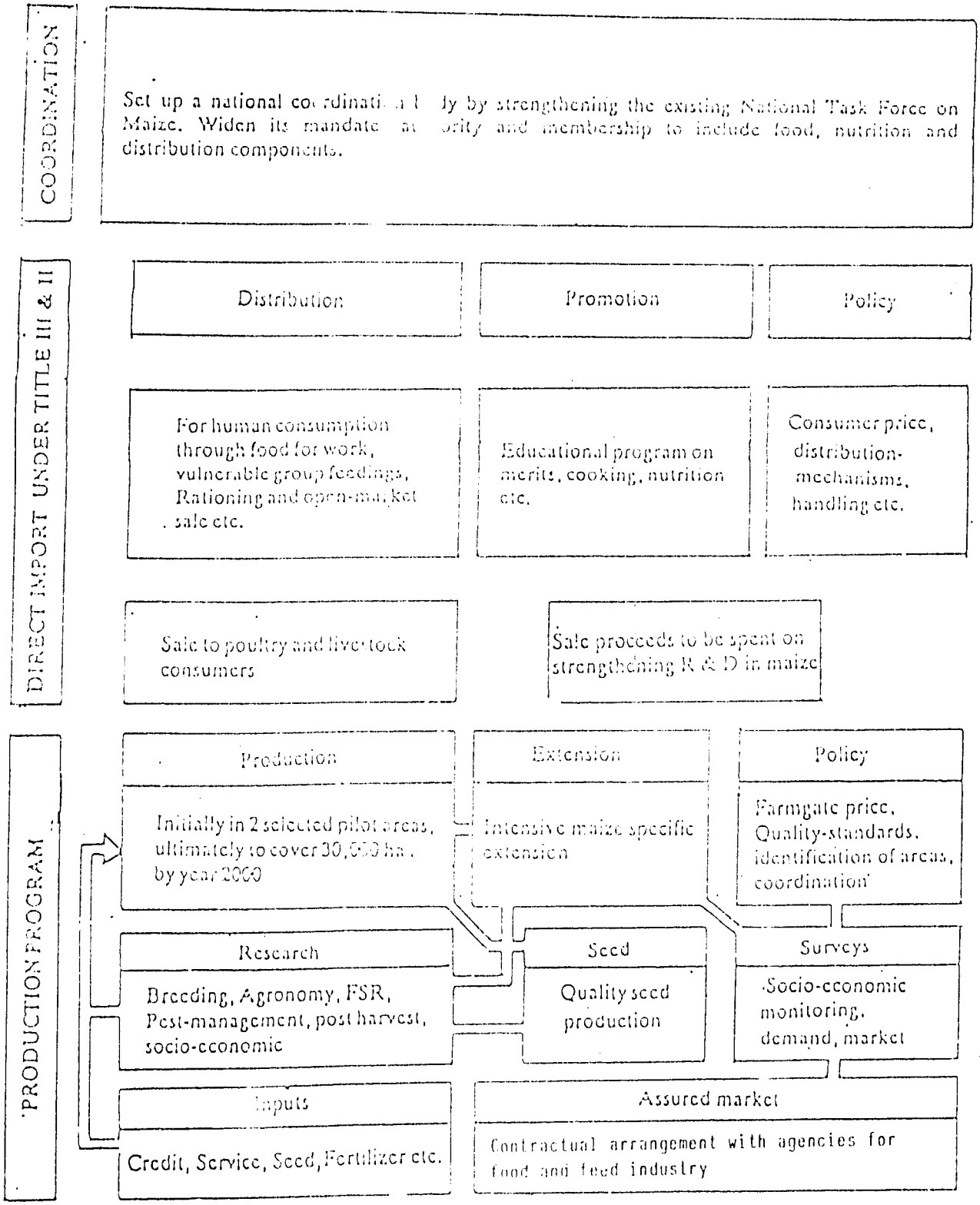

Fig. 5.2. Major Components of the Proposed National Maize Development Program

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5.2. Research Preparedness and Priorities

Maize has been researched in Bangladesh since early seventies but due primarily to lack of funds, emanating from lack of government interest and policy, limited results have been achieved. Scientists at the Bangladesh Agricultural Research Institute have conducted preliminary research in the following areas.

- varietal adaptibility,
- response to fertilizers including MPNS.
- response to irrigation and drainage,
- inter-cropping and mixed cropping,
- plant density,
- disease-pests surveys,
- socio-economic studies including marketing,
- storage practices, and
- cropping pattern analyses.

Field trail results are also available with the Mennonite Central Committee (MCC), However, more systematic and coordinated on station and on-farm research is required to be conducted for at least three consequtive years to lead to recommendations that can be safely made to Maize farmers (Frazier, per. com). Post harvest studies on shelling, drying, storage and bulk handling need to be initiated. Equally important are hitherto neglected studies on utilization, consumption and nutrition. A project proposal prepared by Bangladesh Agricultural Research Institute was submitted in 1983 to BARC for funding. It was never approved. It was aimed at on-station and on-farm research on maize agronomy. The title and summary of the budget of this project are reproduced in Annex 5.2

(Frazier, 1983). The agronomic research priorities identified in this document still remain valid. A comprehensive list of overall research priorities on Maize is given:

- Surveys on agro-edaphic adaptability, socio-economic acceptance, profitability, marketing, food use and utilization.

- On-station research on varietal trials, agronomic needs, water management, fertilizer practices pest mangement, cultural practices, population density, harvesting and shelling, drying and storage.

  On-farm research on production practices, adaptibility, input management, fodder utilization, storage and utilization of grain.

- Nutrition and Home Science research on utilization and food use, and recipes.

5.3. Links with Outside Research Agencies

To make rapid progress in research in minimum possible time, the research scientists working on maize in Bangladesh would have to maintain close and constant touch with outside research agencies, particularly CIMMYT in Mexico and regional program in Bangkok. The inputs from outside agencies will include training, technical assistance and transfer of materials as well as technology.

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5.3.1. Training

Based on the existing gaps a tentative schedule is presented (Table 5.3). Allocation of funds for this training has been made in the provision budget given in Table 5.2.

Table 5.3. Tentative Training Schedule to Help Strengthen Research and Development of Maize Improvement Program in Bangladesh

Area	Year	Person months	Place
Utilization and Processing	1988 1988 1989	4 x 2 m 3 x 4 2 x 30	Texas A & M and CIMMYT
Utilization and Nutrition	1988	1 x 12	Purdue University
Breeding Techniques	1988-90	2 x 30	CIMMYT
Agronomy & Management	1989-91	2 x 30	CIMMYT
Seed Production and Processing	1989-90	2 x 12	Mississippi State University
Study tours: India Thailand	 1989 1991	 2 x 3 3 x 1	 Pant Nagar Bangkok, Khonkaen

5.3.2. Technical Assistance

Technical assistance from CIMMYT would be required on continued basis to help push the breeding program at an accelerated pace. Materials and technology generated at CIMMYT would be easily available if CIMMYT scientists would make periodic visits to Bangladesh. A memorandum of understanding already exists between the GOB and CIMMYT.

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Under this agreement Bangladesh has free access to technical assistance, know-how and materials of CIMMYT. It is recommended that a team of two CIMMYT scientists visit Bangladesh in late 1988 to help prepare a research scheme for five years. Thereafter, at least one visit per year of a breeder, agronomist, pathologist or entomologist (depending on the need) may be required for five years. Bangladeshi senior, and junior, scientists would be visiting CIMMYT and other maize improvement centres in USA for short and long term training.

5.3.3. Materials and Technology

One of the prerequisites of maize improvement program is an appropriate germplasm base including advance breeding lines available with CIMMYT. Bangladesh has specific requirements, quite distinct from the Latin American ones, e.g. flint yellow kernels are preferred over dent types. Once basic materials are made available, local scientists in cooperation with, and under the guidance of CIMMYT scientists, can breed suitable lines.

Apart from seed, the production technology, shelling and drying techniques, storage methods, seed maintenance techniques under farmers' conditions and other appropriate methodology have to be transferred from outside. Also required will be cost effective shelling and drying tools and storage facilities suitable for small farm operators.

5.4. Appropriate Production Technology

Maize yield estimates, in Bangladesh, ranging from 1 to 14 tons/ha of grain have been reported by various investigators. The quality of grain shows considerable variability. The reasons for these large variations could be traced to the lack of uniform production technology followed by farmers under different growing conditions. Researchers would need to standardize the production technology for different intended end-products of maize and for different locations. Production in the winter season is likely to cause lesser problems for drying and storage. For large drying operations, seed driers designed for paddy can be effectively used. These can be produced locally in Comilla.

In the monsoon season (Kharif-1 crop) these aspects need special attention. Fertilizer and water requirements would need to be worked out for specific conditions. On farm fertilizer demonstration trials should be carried out throughout the intended growing areas. As maize production grows in the country the insect and disease problems will increase. Appropriate research in this area should be initiated right from the beginning. Annex 5.2 outlines maize production technology in brief.

5.5. Extension

The Department of Agricultural Extension has conducted on-farm trials on maize sporadically at various locations in Bangladesh. The data generated are not systematically compiled. However, based on our discussions with several extension personnel the following could be concluded.

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- Maize can be a good substitue for upland Aus rice crop which is risky and low yielding. With comparable inputs, maize would give better returns to farmers. Maize has been grown successfully under rain-fed zero-tillage conditions. At the same time it responds very favourably to high inputs. Maize matures earlier than Aus rice.

- Failures in the extension of this crop in the past could be ascribed to a lack of assured market on the one hand and deficiency of quality seed on the other.

Maize extension workers interviewed are convinced that a crash program on maize, supported by a sound package of practices and some credit and promotion, would be successful. They too agree that maize has the potential of becoming the third important cereal crop of Bangladesh with added benefits of fodder, fuel and flexibility of harvesting time.

In response to the recommendations of the Task Force on Maize set up by the Ministry of Agriculture, the Department of Agricultural Extension initiated a program of intensive cultivation of Maize in February 1987. A thousand acres of maize, spread over twenty Zilas, were planned to be brought under cultivation. An arrangemnet was made with the Phoenix Poultry Ltd. to lift the entire produce at Taka 175-180 per maund. It is of interest to note that farmers of Rangpur and Dinajpur refused to sell their produce at the stated price to the Phoenix Poultry Ltd. since they could sell the same at more than twice that price in the local markets. (Annex 3.1)

From our discussions with extension officials it became clear that inter-departmental cooperation and coordination are necessary to prepare sets of recommendations for the farmers of different districts of Bangladesh. Also the timely supply of requisite quantities of seed and other inputs is necessary.

Sample of a simple pamphlets for the extension of maize among farmers are given in Annex 5.4, and 5.5. These recommend maize both for cultivation and consumption.

5.6. Seed, its Requirement and Production

Lack of quality seed has been mentioned to be one of the bottlenecks of the maize expansion program in Bangladesh. Some imported seed from Thailand, seed produceed by the Savar dairy farm (Savar 1 and 2) and some non-descript open pollinated types, retained by farmers from the bulk of the seed supply in the country. Researchers at BARI have received some advanced lines of seed from CIMMYT from time to time; so have some non-government voluntary agencies. Following observations could be made:

- Bangladesh, requires adequate 'starter' seed quantity of a flint-type yellow-coloured, disease resistant, early maturing open pollinated variety of maize that can be multiplied at farmers' level without the risk of running out in the next 3-4 years.

  Conservative seed requirements for the suggested expansion program are given in Table 5.4.

Table: 5.4. Seed Requirements as per Expansion Program Suggested in this Report

Year	Area '000 ha'	Tons of seed needed @ 20 kg/ha	To be imported	Cost @ $1000/ton '000 $'
1988	5	100	100	100
89	8	160	200	200
90	12	240	200	200
91	20	400	200	200
92	30	600	100	100
93	45	900	100	100
94	50	1000	100	100
95	55	1100	100	100
96	55	1100	100	100
97	55	1100	50	50
98	60	1200	50	50
99	65	1300	-	-

- It should be ensured that the maize imported under the PL-480 program does not get used as seed, particularly if it is of hybrid origin and of dent rather than flint nature. Farmers and extension workers would need to be educated to know the difference between the edible and seed types.

- If any grain is made available specifically for the food production purposes, which is likely to be of hybrid origin and perhaps late in maturity, it should be ensured that the same does not get mixed with the open pollinated seed varieties. Similarly, the seed varieties used in very small quantities for popcorn and sweet corn purposes should be kept isolated. Best solution for avoiding undue mixing is to produce seed at isolated locations and strive for a general purpose variety for grain and fodder.

- Realizing that in the absence of a sound seed production base, maize can not be expanded quickly, it is recommended that a seed production program for maize be launched by the BADC. An allocation of $300 thousand has been made in the proposed budget for a sound seed production program, including for the provision of some seed processing equipment in the first year of operation.

- In the first two years of expansion program atleast three tons of quality seed would need to be imported from abroad. This seed should be of flint nature and not a hybrid. A composite or synthetic variety would be required. As local breeding research and seed production effort grow, the need for imported seed will gradually taper off.

- Farmers would need to be educated in the maintenance of quality, proper handling and storage of seed. Seed quality can be maintained at 14.5% moisture.

- The Bangladesh Poultry Development Association has expressed interest in the production of quality seed through contractual arrangements with BADC and with the contract farmers. This possibility should be further explored since it would definitely be more effective than leaving the responsibility of seed production with the BADC. Table 5.5 traces the stages of seed production, organizations involved and the price ratio. Figure 5.3 outlines a model incorporating involvement of private seed growers in maize production.

Table 5.5. Sequential Steps in Seed Production

Type of Seed	Breeder's	Foundation	Certified	Commercial	Grain
Organization	BARI	BARI	BADC	Private Growers	-
Seed price ratio	-	100	10	5	1

- Appropriate drying techniques and storage containers would need to be researched to recommend cost-effective techniques to farmers.

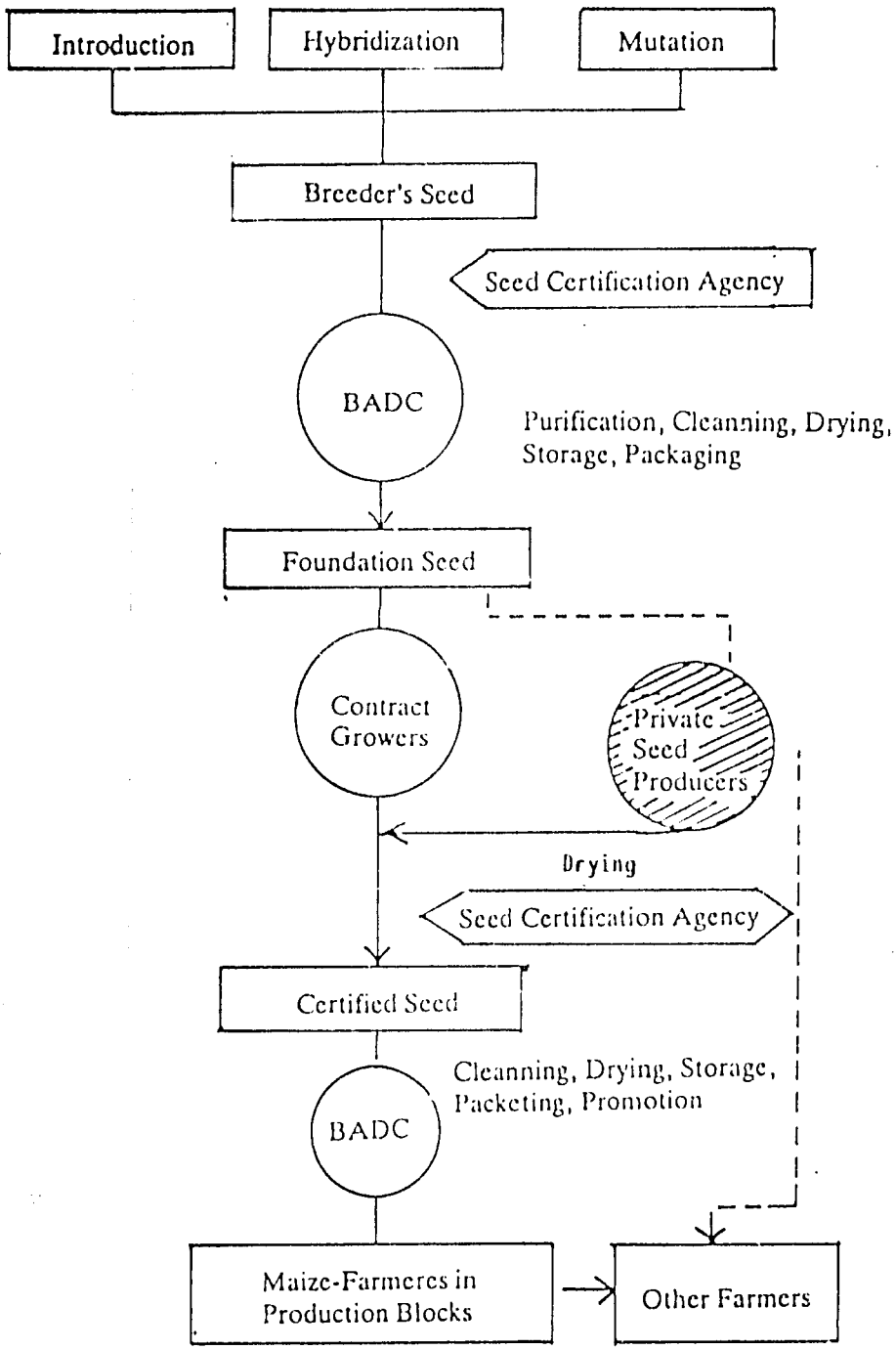

Fig. 5.3. Rapid Flow of Quality Maize Seed from its source to End Users

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7. ANNEXES

Annex: 3.1(a) Letters Address to Managing Director, Phoenix Poultry Limited Indicating Higher Prices Being Offered to Farmers for Maize Than the Contract Prices.

গণ প্রজাতন্ত্রী বাংলাদেশ সরকার
উপ- পরিচালক এর কার্যালয়
কৃষি সম্প্রসারণ বিভাগ
রংপুর জোন, রংপুর।

স্মারক নং:- ৭৯৪৩ তাং:- ২/৫/৮৯ ; ১৬/৫/৮৯

বরাবর,

মাননীয় ডিরেক্টর
ফেনিক্স পোলট্রি লিমিটেড
১৬, মতিঝিল বাণিজ্যিক এলাকা,
ঢাকা।

বিষয়:- গবিপ - ১ মৌসুমের উৎপাদিত ভুট্টা দানা বিক্রয় প্রসংগে।

উপরোক্ত বিষয়ের পরিপ্রেক্ষিতে আপনার অবগতির জন্য জানানো যাচ্ছে যে, অত্র রংপুর জোনের বিভিন্ন উপজেলার স্থানীয় হাট বাজারে ভুট্টার মন ৩০০/০০ টাকা দরে বিক্রয় হচ্ছে। ভুট্টার রূপ হিসাবে প্রতিটি ২/- ৩/- দরে বিক্রয় হচ্ছে। ১৮০/০০ টাকা মন দরে ভুট্টাচাষীদের ভুট্টার দানা বিক্রয় করতে রাজী না হওয়ায় আপনার প্রেরিত প্রতিনিধি মি: আইয়ুব কাদ্রীকে ভুট্টা দানা সরবরাহ করা সম্ভব হলো না।

উপ- পরিচালক
কৃষি সম্প্রসারণ বিভাগ
রংপুর জোন, রংপুর।

স্মারক নং:- তাং:-

অনুলিপি সদয় অবগতির জন্য প্রেরণ করা হলো :-

১। পরিচালক কৃষি সম্প্রসারণ সদরদপ্তর, খামার বাড়ী, ঢাকা।

২। আঞ্চলিক পরিচালক, কৃষি সম্প্রসারণ বিভাগ, রংপুর অঞ্চল, রংপুর।

উপ- পরিচালক
কৃষি সম্প্রসারণ বিভাগ
রংপুর জোন, রংপুর।

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০২/০৬/৮৯ ইং।

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Annex: 3.1(b) Letter Addressed to Director, Agricultural Extension (FS) Indicating Higher Prices being Offered to farmers for Maize than the Contract Prices.

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
উপ-পরিচালকের কার্যালয়
কৃষি সম্প্রসারণ বিভাগ, দিনাজপুর জোন,
দিনাজপুর।

স্মারক নং:- তারিখ:----------

বরাবর,

পরিচালক,
কৃষি সম্প্রসারণ বিভাগ (সেক্টর অফিস)
বাংলাদেশ, ঢাকা।

দৃষ্টি আকর্ষণ:- জনাব মধুসূদন সরকার, অতিরিক্ত পরিচালক (সেক্টর অফিস)।

বিষয়:- ভুট্টা চাষীদের উৎপাদিত ভুট্টা দানা বিক্রয় প্রসঙ্গে।

সূত্র:- পরিচালক (সেক্টর অফিস) এর স্মারক নং- সম্প্র-এম-৩/৮৫-১৪৮২(৭০) তাং- ৭-৩-৯৪ খৃং / ২২-৩-৮৭ ইং

উপরোক্ত বিষয় ও সূত্র অনুযায়ী আপনার সদয় অবগতির জন্য জানানো যাইতেছে যে, কমিল্লা পেলেট্স লিমিটেড এর চুক্তি খোরাকের ১৮০ (একশত আশি) টাকা মন দরে অত্র দিনাজপুর জেলার কৃষকগণ ভুট্টা দানা বিক্রয় করিতে অনিচ্ছা প্রকাশ করিয়াছেন। কারন বর্তমানে বাজারে যে দেশী ভুট্টা দানা বিক্রয় হইতেছে, তাহা প্রায় ৩০০ (তিনশত) টাকা হইতে ৪০০/- (চারশত)।

আরো উল্লেখ্য যে, স্থানীয় বাজারে প্রতিটি ভুট্টার বোটা ০.৫০ টাকা হইতে ১/- টাকা দরে বিক্রয় হইতেছে। কাজেই অত্র জেলা হইতে কোন ভুট্টা দানা কমিল্লা পেলেট্স লিমিটেড এর নিকট বিক্রয় করা সম্ভব হইতেছে না।

ইহা আপনার সদয় অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহনের জন্য প্রেরন করা হইল।

উপ-পরিচালক,
কৃষি সম্প্রসারণ বিভাগ, দিনাজপুর জোন,
দিনাজপুর।

স্মারক নং:- ১৪৪৬/১(2) তারিখ:- ২৭/৬/৯৪

অনুলিপি অবগতির জন্য প্রেরন করা হইল :-

১। আঞ্চলিক পরিচালক, কৃষি সম্প্রসারণ বিভাগ, রংপুর অঞ্চল, রংপুর।
২। জনাব সামিউল আহসান, ম্যানেজিং ডাইরেক্টর, কমিল্লা পেলেট্স লিমিটেড, জি.পি.ও বক্স নং ২৬১৮, ঢাকা।

উপ-পরিচালক,
কৃষি সম্প্রসারণ বিভাগ, দিনাজপুর জোন,
দিনাজপুর।

গমপস/

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Bright prospect of maize cultivation in Narail

Our Correspondent

NARAIL, Sept. 6:—There is a bright prospect for maize cultivation in Kalia, Lohagora including Sadar Upazila of Narail District, it is known.

According to wise farmers of the localities, maize can be grown all the years round in the country. It can be grown in the gap between the main cropping seasons without affecting the major crops. The other advantage of maize is its deversified uses. Maize can be used as green cobs, popcorn, flour and grils in flood. Maize can be used for livestocks and poultry.

Maize can be grown in the district from December to March without affecting transplanted crop. If maize can be substituted for local aus grain production will be higher.

When asked about the economics Mr. Abdur Rashid Mia, Subject Matter Specialist, Narail informed this correspondent that average cost of production of maize was Taka 4,300 per hectare and net profit ranged between Taka 6,614 and Taka 9,386. Grain yield potential of maize is almost double of that of paddy and wheat. It may be produced 8 to 10 tons per hectare.

Maize is recognised for its high yielding capacity and enormous agronomic flexibility and adaptability and above all for its versatility of end uses. The textile industry has an assured demand of several thousand tons of maize grain, he said.

Source: Bangladesh Observer dated 8 September 1987

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BANGLADESH POULTRY DEVELOPMENT ASSOCIATION

amazi chamber 16, Motijheel C/A Dhaka-2, Bangladesh Ph: 252407 251454 Telex: 642422 BKT BS.

Ref. No. BPDA/MLF/86/131

The Joint Secretary,
Ministry of Fisheries & Livestock,
Bangladesh Secretariate,
Dhaka.

Sub:- Importation of 10,000 M/Tons of Yellow Maize under grant or Aid for Private Poultry Farms.

Dear Sir,

We would like to inform you that in our last executive committee meeting of Bangladesh Poultry Development Association, held on 18.12.86 and it is unanimously decided in the said meeting that the Bangladesh Poultry Development Association will request to the Ministry of Fisheries & Livestock for importation of 10,000 (Ten thousand) M/Tons of Yellow Maize under grant or Aid from abroa That imported maize will be sold among the Private Poultry farms lower than the LSD rate of wheet which will be mutually agreed upon and the sale proceeds of maize will be utilized for the development of private poultry industry in Bangladesh.

So, we like to request you, necessary arrangement may please be made for importation of 10,000(Ten thousand)M/Tons of Yellow mai under grant or aid for private poultry farms.

Thanking you.

Yours faithfully,
For Bangladesh Poultry Development Association

(Samiul Ahsan)
President.

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Maize yields several hundred products, by-products and raw materials. These could be classified on the basis of their end use into following categories:

(1) Food

(2) Textile Industry

(3) Pharmaceuticals

(4) Chemical Industries

(5) Construction

(6) Explosives and

(7) Cosmetics.

A list of Products is given.

LIST OF PRODUCTS ORGINATING FROM MAIZE

Paper and paper products: parchment

Adhesives

Bakery products

Bakery ingredient and ingredients

Salad dressing

Dry batteries

Canned food

Binder compounds

Boiler compounds

Briquettes

Chewing gum

Colour carrier in paper printing

Cones for ice cream

Confectionery

Cosmetics :talcum & face powder, toothpaste & tooth powder

Clarifying agents

Coating on wood, metals and paper (ethyl starch)

Dressings

Surgical

Dyes

Explosives: dynamites, fireworks, nitrated starch

Fish food

Food thickening agents: (Cream soup, Gravies, Chop suey, Chilli corn)

Insulating materials (wall boards etc.)

Acids: Levulinic, Oxalic, Acetic, Lactic, Citric, Glyconic, Amino.

Mustered preparation

Oil well drilling

Oil cloth

Paints (cleaning compounds, cold water pastes, posters & sizing)

Paste for wall paper etc.

Pharmaceutical: Binder, Extender in tablets, Nutrient medium for penicellin and for antitoxics for gas and gangrene etc.

Plastics

Resins

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* Adopted from M.A. Sami, 1979

Containers

Core binders

Moulded toys etc

Additive to table salt

Sausage filler

Soaps & cleaners

Stabilizing agents

Textiles (wrap sizing, finishing & printing)

Acetaldehyde

Alcohol

Denatured alcohol

Antiseptics

Antifreeze

Biological preparation

Brake fluid

Butadeire

Candy glazes

Compasses

Thermometers
Spirit levels etc.

Chemicals

Dentifrices

Deodorants (body & nonbody)

Disinfectant

Embalming fluids

Ether

Protective colloides (emulsions)

Rubber goods

Ring backing

Floatation agents

Hair tonic

Insecticides

Lacquers & moulded products

Articicial leather

Liniments & drugs

Nitrocellulose

Oil cutting

Pectin

Photographic films

Polish for shoes & floors

Rayon

Rubbing compounds

Synthetic Rubber

Laboratory use

Sheliac solution

Solvents (food & medicinal)

Sorbitol

Torpedo (Powder fuel for propulsion)

Toilet preparation, scalp preparations, perfumes & perfume materials, toilet soaps, shaving creams, etc.

Ethelene gas

Gasohol (for motors)

Vinegar

Vitamin preparation

Aeroplane dopes

Chemical agents
(Solvents, detergents
dehydrating agents, defrosters, penetrants viscocity
reducer, blending agent)

Chemical raw materials

Butyl acetate

B. Acetyle recinoleate

B. Acetyle recinoleate

B. ether, b. lactate,
B. stearete dibutyl phthalate, di-B sebacale,
diB. Tartrate, tri-B citrate
Tri-B phosphate, B.borate,
B. Olitate, B. Ricinoleate,
ditutoxymethane, di-B oxalate
etc.

Esters and salts

Finishes, synthetics

Printing inks

Hydraulic break fluid

Penetrating oils

Ore floatation agents
Leather tanning
Paper coating and stencils

Reagents

Frozen food products
cream, eggs, jaice, etc.

Rust removers

Solvents

Insect sprays

Synthetic flavours

Beverages

Candy glazes

Catsup & tomato sauce

Cheese spreads

Citrus juice

Condensed milk

Chemicals:

Calcium lactate

Sodium lactate

Distriller products

Electroplaing & galvanizing compounds

Flavouring extracts

Florists preparations

Foam stabilizer in fire fighting equipment

Hot patches for tiro repair

Jam, jellies, marmaleds, pickles and preservative

Licoroice

Lotions

Marshmallow

Meat products

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Fruits candies

Ice creams sherbets

Infant & invalid feeding

Intravenous Injection

Leather tanning

Meat curing

Meat additives

Mincement preparation

Pectins

Plasticizing materials
& standerdizing agents

Emergency rations

Sauces

Soap de' ydraulic

Vinegar

Vitamin 'C' (via ascorbitor
sorbose etc.)

Syrup, cough syrup,
medicinal, sodafountain,
malt, fruits etc.

Binding age for
vegetable drying compounds

Corn flakes

Desserts

Doll heads

Felts

Food thickening agent

Fritters

Myonnaise

Porridge

Plywood manufacturing

Pudding & custard

Beverages

Carpet & rug sizing

Cigarette sealing

Crayons (chalk)

Ceramics

Antioxidants

Chemical Agents: for refining,
purification, dewaxing,
procipitant, dehydrating etc.

Chemical raw materials,
(diacetone, mesityle oxide,
iodoform, chloroform amylac-
cetate, denaturant for othyl
alchol formulas 23-A & 23-H)

Enzymes

Extraction of essential oils

Nail polish remover

Paint remover

Pyroxylin cements and plastics

Solvent: acetylene

Aeroplane dopes

Ammunition

Carrying agent for vitamins

Cooking oil: Margerine &
Oleomargerin

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Hominy (boiled)
Fire works

Flatation agents
(Molybdenum)

Gums

Glues

Linoleum: cement & paste

Matches (on head & box)

Mucilages

Oil cloth

Oil well drilling

Paints (cleaning compounds,
cold water pastes)

Plywoods

Soap & cleaners

Straws

Tubes, spirals & convolute

Twine

Window shades

Asbestos

Esters & salt

Food preparation (cheese,
jam, fruit essence, etc.)

Fruit pectins

Medicines

Rust preventive (surface coating)

Shortening

Sulphurized methyl esters of fatty
acids & adjuncts to motor oil

Canned maize

Ear corn

Pop corn

Cork (granulated) substitute

Cob-meal, for cleaning furs,
burnishing metal, removing oil
from tins and metals, sweeping
compound, removing carbon from
automobile, aeroplane engines,
light weight ceramics tile, etc.

Decolourizing solvent

Filler for plastics

Furfural

Pipe Bowls (smoking)

Corks

Doll making

Felts

Paints (sizing)

Caramel colour

Vinegar

Fodder

Tamale

120

Annex: 4.1 Recipes for Some Popular Maize Based Foods

1. Based on Flour

1.1. Roti

Ingredients

Maize flour	100 g
Salt	to taste
Hot water	as required

Method

Sift the maize flour. Make a smooth dough by kneading using hot water. Make two to three balls, roll into roti, cook on a hot taba or flat pan. Serve hot.

1.2. Paratha

Ingredients

Maize flour	100 g
Oil or fat	10 g
Salt	to taste
Hot water	as required

Method

Mix flour and salt. Divide the flour in two portions. Add hot water to one portion and knead it till a smooth dough. Make one or two balls and then flatten into a thick roti with the balna (roller). Put a little oil on the hot iron flat pan and place the roti on it. Spread it more, if required, with the help of wet fingers. When cooked from one side, add a little oil and cook from the other side. Serve hot with meat curry or vegetables curry.

1.3. Mixed roti

Ingredients

Wheat flour	75 g (75%)
Maize flour	25 g (25%)
Salt	to taste
Hot water	as required

Method

Sift the wheat and the maize flour together. Knead into a dough using warm water. Make two or three balls and roll into roti with the help of roller. Cook the roti on a flat iron pan. Serve hot with curry or sweet

1.4. Potato - maize roti

Ingredients

Potatoes	4 (medium size)
Maize flour	100 g
Salt	to taste
Chilli powder	1 tsp
Ghee	20 g

Method

Boil potatoes, remove the skin and then mash. Mix the flour, potato mash, all the spices and knead well. Make small balls and prepare rotis. Bake well on both sides with a little ghee. Cook the roties on a hot tava with little ghee or oil.

1.5. Puri

Ingredients

Maize flour	one cup
Wheat fleur	one cup
Salt	to taste
Water	as required
Oil	250 g

Method

Sift the wheat flour and maize flour together. Add salt and sift again. With measured out water make the dough using the flour mixture. Break the dough and roll them into four to five roties. Fry them in hot oil. Drain from the oil and serve hot with curry.

1.6. Maize pancakes

Ingredients

Maize flour	100 g
Salt	to taste
Egg	one
Milk	300 ml
Ghee	for frying

Filling

Maize ears	2
White sauce	1 cup

Method

Cook maize ears in boiling water to which salt is added. Remove kernels from the ear. Mix with white sauce. Sieve flour and salt. Beat the egg and add to the flour. Add milk gradually to form a smooth batter. Heat the frying pan. Apply a little ghee and a handful of the butter and spread in evenly. Place a little maize kernel-sauce mixture in the centre of each pancake and roll. Serve these hot, garnished with green coriander leaf.

1.7. Maize flour - meal mix

Ingredients

Maize flour	200 g
Salt	to taste
Sugar	150 g
Baking powder	1/4 cup
Shortening	100 g
Maize meal	1000 g

Method

Sift and measure flour, add salt, sugar and baking powder stir to blend and sift together twice. Add shortening and cut in with knife or finger tips, until shortening lumps are finely distributed. Add maize meal and mix throughly. Measure mix by piling lightly into cup and levelling with a spatula. Make about 11 cups of mix.

1.8. Loaf bread

Ingredients

Maize flour	1 cup
Wheat flour	2 cups
Sugar	1 tsp
Yeast	1 tsp
Salt	to taste
Water	3 cups
Ghee	1 tsp

Method

Activate yeast in one cup of warm water and add a spoon of sugar. Let it stand for 10 minutes. Sift the flour and salt together. Add yeast solution to the flour and mix. Add enough water to form a soft dough. Place the dough in a greased bowl with the wet cloth to cover. Let the dough stand for a while until it raises double its size. Knead the dough by punching the air out for 2-3 minutes. Keep it in a greased bowl for 30 minutes or in a bread pan. Bake at 220 degree C for 30 minutes.

1.9. Muffin

Ingredients

Maize flour	25 g
Sugar	10 g
Baking powder	1 tsp
Salt	to taste
Milk	20 ml
Egg	one
Ghee	1 tsp

Method

Sift dry ingredients together. Add milk to egg and melted fat. Combine mixtures for muffins, stir to mix ingredients. Pour butter into oiled muffin pans. Bake in a hot oven (220-230 degree C) for 15 to 20 minutes. Remove from pan at once.

1.10. Maize kheer

Ingredients

Maize suji	100 g
Ghee	1/3 cup
Sugar	1/2 cup
Milk	4 cups
Cardamon	2 -

Method

Fry suji in fat and add milk. Cook on slow fire, stir constantly till atleast half the milk is absorbed. Add sugar and cook till sugar is dissolved. Add cardamom seeds. Serve cool.

1.11. Maize cake

Ingredients

Maize flour	100 g
Wheat flour	50 g
Baking powder	4 g
Salt	to taste
Sugar	110 g
Ghee	100 g
Nuts (chopped)	1/2 cup
Milk	1/4 cup
Egg	1
Essence	a few drops

Method

Sift flours with baking powder and salt. Beat the egg well. Cream sugar and ghee till light and fluffy. Add beaten egg and essence and mix. Add the dry ingredients and mix. Add milk if necessary to give the batter a pouring consistency. Add chopped nuts. Pour into a greased and floured pan. Bake for 40-50 min. at 190 degree C.

1.12. Maize biscuits

Ingredients

Maize flour	200 g
Butter	100 g
Powdered sugar	100 g
Essence	few drops
Milk	to mix
Baking powder	1/4 tsp

Method

Sieve flour and baking powder together. Fold in butter into the flour. Add powdered sugar. Work in flour with hands using as much milk as necessary to make a pliable dough. Add essence and mix, roll out and cut into desired shapes. Bake at 175 degree C for about 15 minutes.

2. Based on Grits

2.1 Maize khichuri

Ingredients

Maize suji	400 g
Green gram dal	150 g
Ghee	100 g
Cashewnuts	20 g
Salt	to taste
Water	600 ml
Green chillies	8-10

Method

Fry the suji in a little amount of ghee. Boil the water with salt and add green gram dal. When dal is half done, add suji and stir. Keep stirring until it is done. Fry cashewnuts. Add to pongal. Fry green chillies in ghee and add that to khichuri.

2.2 Maize-Rice khichuri

Ingredients

Tender maize kernels	150 g
Rice	300 g
Ghee	1/2 cup
Ginger extract	1 tsp
Zeera	1/4 tsp
Cinnamon	a small piece
Cloves	2-3
Mustard seeds	1/2 tsp
Salt	to taste

Method

Soak rice. Heat ghee, add all the dry spices followed by rice and maize. Add salt, ginger extract and water to cover the mixture. Allow it to boil.

2.3. Maize meal rolls

Ingredients

Egg	
Milk	150 ml
Maize meal mix	500 g

Method

Beat the egg. Add milk and stir into the milk until well blended. Place dough on a well-floured board and knead lightly about ten strokes. Roll dough to 1/3 inch thickness. Cut with biscuit cutter and fold. Bake on lightly greased baking sheet in a hot oven (200 degree C) 12-15 minutes.

2.4. Cheese puffs

Ingredients

Egg	1
Milk	125 ml
Grated sharp cheese	150 g
Maize meal mix	300 g

Method

Beat egg slightly, add milk, cheese and mix. Stir until well blended. Form the dough into bite size balls. Fry in hot oil until golden brown. Drain on absorbent paper. Serve hot.

2.5. Maize fritters

Ingredients

Egg	1
Milk	125 ml
Maize meal mix	500 g
Whole kernel corn drained	350 g

Method

Beat egg slightly, add milk, maize meal mix and whole kernel. Stir until well blended. Drop dough from a table spoon into hot oil. Fry until golden brown. Drain on absorbent paper. Serve hot with syrup.

2.6. Maize pullao

Ingedients

Tender maize kernels (boiled)	250 g
Rice	250 g
Chopped onion, ginger, green chillies	as required
Ghee	for frying
Other spices for normal pullao	as required

Method

Wash rice and soak for 10 minutes. Heat ghee and fry masala, rice and boiled maize. Add 3 cups of water and let it cook. When it is cooked, remove and serve hot.

2.7. Maize - rice mixed boil

Ingredients

Maize grits	100 g
Rice	100 g
Water	2 litre
Salt	1 tsp

Method

Add the maize grits to the boiling water. Cook for ten minutes. Add rice gradually. Add salt to it and mix thoroughly. Take off the fire, when both rice and maize boiled properly. Drain out the water. Serve with curry.

2.8. Maize porridge

Ingredients

Broken maize	60 g
Milk	100 ml
Gur/sugar	50 g
Ghee	50 g
Water	500 ml approx.

Method

Soak broken maize in water sufficient to cover it for one hour. Drain water and keep it aside for cooking. Roast soaked maize till golden brown. Heat Ghee. Fry roasted maize for 5 minutes. Add water. Cook on slow fire with lid on till soft. Add gur/sugar to the porridge and mix well. Remove from fire. Add milk while serving.

3. Based on Green Cobs and Popcorn

3.1. Maize cobs

Method

Remove the husk from the ears. Roast on a slow charcoal fire till done. Serve hot.

or

Boil the ears in sufficient quantity of water. Remove from water and apply mint chutney, salt and lemon juice. Serve hot.

or

Roast the ears in heated sand. Remove from the sand and apply lemon and salt. Serve hot.

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3.2. Green maize cobs

Ingredients

Tender maize ears	12
Large coconut	1
Bunches coriander leaves	8
Green chillies	6-10
Lemon	1
Salt	to taste
Hot water	2 cups

Method

Grate and graind the coconut, pour hot water and extract as much milk as possible. Grind together the coriander leaves and green chillies along with a little salt till fine. Remove the husk of the maize ears and lay the ears out evenly in a bottom of a heavy vessel. Mix the ground masala into the coconut milk and pour over the ears, add enough water to bring to the level of the ears. Cook over moderate heat turning the ears individually from time to time to ensure that they are evenly cooked. When almost dry, test for seasoning and add lemon juice. Reduce heat and cook till dry. Shake the pan gently from side to side to coat the ears with masala.

3.3. Boiled maize

Ingredients

Maize ears (fresh)	10
Ghee	1/2 cups
Salt	to taste
Onion	1
Green coriander	a few leaves
Green chillies	4-6
Lemon	2

Method

Boil the maize ears in water and separate the kernels. Chop green chillies and onion. Fry chopped onions and chillies in ghee. Add boiled maize grains, salt and coriander leaves. Cook it for a while. Remove the pan from fire and add lemon joice.

3.4. Fried maize

Ingredients

Tender maize ears	2
Milk	30 ml
Ghee	15 g
Salt and pepper	to taste

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Method

Remove kernels from the cobs. Heat the milk and when it comes to boil, add the kernels. Cook till maize is dry and the milk has evaporated. Remove from heat. Heat ghee in a deep frying pan and add the cooked maize kernels.

3.5. Popcorn

Ingredients

Popcorn	150 g
Oil	100 g
Salt	to taste

Method

Clean pop corn kernels and ensure that they have 14-15% moisture for obtaining maximum popping volume. In a heavy based pan add 100 ml of oil, heat till it produces smoke (240 degree C). Add popcorn kernels and quickly cover with lid. Fry with constant shaking till popping sound stops. Add salt to taste.

3.6. Maize bhaji

Ingredients

Maize (whole kernel)	50 g
Potatoes	25 g
Onions	5 g
Fat	5 g
Spices	as required

Method

Boil the maize in water till soft but firm. Chop onions and roast in cooking oil till brown. Add chopped potatoes. Cook till soft. Add all condiments and maize. Stir the mixture, sprinkle a handful of water on it and cover it quickly, leave it on the fire for 3-4 minutes. Serve it hot.

3.7. Maize curry

Ingredients

Oil	60 g
Maize ears boiled and cut in (2" or 3" pieces), Chopped tomatoes	500 g
Coconut milk	1 cups
Onion finely chopped	1
Salt	to taste
Spices	as required
Green chillies	3
Red chillies	3

Method

Fry the chopped onion in oil, till light brown. Add the ground masala, fry for 5 min. then the finely chopped tomatoes and lastly the maize ears pieces. Fry the corn for about 10 min. then add the coconut milk and finally chopped coriander leaves. Let the curry come to boil. Surve with rice or roti.

3.8. Maize pudding

Ingredients

Large maize ears	6
Eggs	2
Flour	120 g
Salt	to taste
Pepper	1/2 tsp
Milk	600 ml

Method

Remove the husks and the silk from the maize ears, cut downwards through the centre of each row of grains, then remove them with the back of a knife. Beat the eggs and add them, stirring carefully, to the sifted flour, salt and pepper. Stir in the milk, then the grains. Pour into a greased pie-dish and bake in a moderate oven (175 degree C) about 1 hour. Serve hot.

3.9. Cutlets

Ingredients

Tender maize ears	2
Besan	200 g
Onions	2
Ginger	a small piece
Salt and chillies powder	to taste
Ghee	for shallow frying

Method

Grate maize ears. Chop onions and ginger. Mix them. Add salt, chillie powder and besan into this mixture. Add a little water and shake the mixture. Smear ghee on a frying pan and fry them till golden brown. Serve hot with tomato chutney or sauce.

(Recipes are prepared with the help of IARI, 1979. Recipes of maize. Indian Agricultural Research Institute, New Delhi, India.)

ANNEX: 5.1

Workshop on Maize Production
and
Utilisation, BARI, March, 1985

CONCLUSIONS AND RECOMMENDATIONS

Based on the information and data presented by various authors, it was concluded that maize had a define potential to contribute to the future food needs of Bangladesh which can be harnessed in a planned manner through short, medium and long range policies. The very prerequisite is to have feed, and fuel definite Government policy to promote maize as a source of food. Also, it was realized that considerable foreign exchange could be saved by utilizing locally produced mazie as a raw material for the industry. It was clear from the data presented that maize grew well in Bangladesh and had a definite place in the farming systems of the country. Its versatility in terms of photoinsensitive behaviour, suitability to rainfed condition, and other physiological attributes makes maize most suitable for widespread production as a sole crop or an intercrokp. From the point of view of its end uses, maize is an extraordinatry crop that can be cultivated to meet the requirements of a subsistance farmer on one hand and for providing industrial raw material through large scale cultivation on the other. Every part of the maize plant has multiple uses. It was realized that considerable inforamti on production technology was available in Bangaldesh which needed to be refined and packaged and passed on to the extension agencies. However, a number of basic issues required to be solved through further research and verification.

The following key recommendations were made:

- Emphasis should be laid upon the development of distinct breeding stragegies for specific end uses namely grain, green cobs, and fodder. Initially, multipurpose stable varieties should be aimed at.
- Appropriate crop production technology should be developed.
- Integrated pest management strategy should be developed to include weeds, pathogens, insects, vertebrates, and storage pests.
- Systematic on-farm trials should be planned around cropping systems testing sites.
- Adaptation studies should be conducted to identify most suitable area of intensive maize production.
- On-station and on-farm trials should be conducted to determine the fertilizer (macro and micro nutrients) as well as water requirements.
- An improved maize sheller should be developed locally.
- Extensive researrch on the utilization of grain and stover as feed, fodder, fuel and silage production should be initiated.
- Marketing constraints should be systematically studied.
- Appropriate techniques for diversified uses of grain should be found and popularized throgh appropriate food technology research.
- Socio-economic studies should be conducted to identify the constraints to increased preduction and adoption of improved tehcnology.

TRANSFER OF TECHNOLOGY

- Existing technology that has been field tested needs to be rapidly packaged and made available to the farmers.
- Technology in the process of development should be verified through widespread on-farm testing under specified agro-ecological conditions.
- Appropriate extension information need to be produced for extension agencies and broadcasting purposes.
- Training requirements at various scientific and para-scientific levels may be identified and steps be taken to initiate systematic training programme without any delay.

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- A close working contact between the extension and research workers need to be established particularly to ensure necessary feed-back to research.

CONSUMPTION, UTILIZATION AND MARKETING

- Utilization of maize as a stape food crop for Bangladesh requires considerable promotional activity. An applied nutrition programme along with a mass eduction programme, on the merits of maize as a wholesome food, should be taken up.

- Relative demand of maize for food, feed and industrial uses should be determined through a marketing survey.

- The Food Technology Section of BCSIR should assist in finding diverse uses of maize and urban nutrition.

SEED PRODUCTION

BADC should initiate action on the production of foundation and certified seeds. Initially seeds of the available cultivars may be multiplied to meet the immediate demand.

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Annex: 5.2 Profile of a Research Project Submitted by BARI to BARC in 1983 on Maize

BARS
Form No. P-1 Bangladesh Agricultural Research Council Received at BARC
RESEARCH PROPOSAL 1/ Date_____
By _____

To be filled in by BARC Research Code No.

Check appropriate Box Coordinate Independently Implemented
Project Title: Coordinated Trial of Coarse Grain Production

To be filled in by BARC Commodity Priority Priority Rank

Implementing Agency/Station(s)/Unit(s)
Extension & Research Project (OFRP) in collaboration with Agronomy and Soil Science Division, BARI and Department of Agriculture Extension. This project is complementary to the Maize improvement project supported by the Ford Foundation.

Coordinator : M. Zainul Abedin, Ph.D.
Designation/Title : Head, Extension & Research Project(OFRP), BARI.
Mailing address : Joydebpur, Gazipur.

Joint Coordinators :
1. Russell D. Frazier, Ph.D. Agronomist, IADS/BARI, Joydebpur.
2. Mr. Mrinal K. Chowdhury, SSO, E & RP, BARI, Joydebpur.

Principal Investigators :
1. Mr. A.K.M.A.Kibria, Additional Director (FCD), DAE, Dhaka.
2. Dr. Abul Kashem, PSO, RARS, Hathazari, Chittagong.
3. Mr. A.B.M. Abul Khair, PSO(E & RP), Jamalpur.
4. PSO, OFRI (E&RP), Ishurdi, Pabna.
5. Mr. Fazlul Haque, PSO, OFRP (E&RP), Jessore.
6. SSO, E & RP, BARI, Rangpur.
7. SSO, E & RP, BARI, Thakurgaon.

Signature :	Submitted by:	Endorsed by Agency Head:
Name:	Dr. M.Zainul Abedin	Dr. M.M. Rahman
Designation/Title:	Head, E&RP(OFRP), BARI	Director, BARI
Date:	21.11.83	

1/ To be accomplished by proponent and submitted to BARC in 5 copies.

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BUDGET ESTIMATE

Line Item	Year - 1					Year - 2	Year - 3
	Qtr.1	Qtr.2	Qtr.3	Qtr.4	Total		
1	2	3	4	5	6	7	8
OPERATIONAL EXPENSES							
a)Salary & Allowance	54	54	54	54	216	219	222
b)Office supplies/services	20	15	12	22	69	69	84
c)Travel & Transporation	10	25	20	25	80	85	85
d)Fuel,Oil & Maintenance	12	18	20	20	70	85	103
e)Field Research Expenses							
i. On-farm Research	46	63	55	68	232	270	299
ii.Water Management	15.5	13	13	13	64.5	57	57
iii.Agronomic Research	21	21	21	21.5	84.5	85.5	86.5
f)Monitoring & Evaluation cost	-	-	-	-	-	-	-
g)Contingencies	10	15	10	10	45	55	60
SUB-TOTAL	198.5	224	205	223.5	861	925.5	996.5
CAPITAL EXPENSES							
a)Furniture	41.6	-	-	-	41.6		
b)Equipment	208.6	87		-	295.6		
c)Motorcycle/bicycle	120	-	-	-	120		
SUB-TATAL	370.2	87	-	-	457.2		
TOTAL	568.7	34	205	223.5	1318.2	925.5	996.5
Revolving Fund	330				300		
Vehicle, Jeep	350				350		
Grand Total	1218.7	34	205	223.5	1968.2	925.5	996.5

$ 121,568 at $1 = Tk.32

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Annex: 5.3 : Summary of Maize Production Technology.

Operations	: Recommended action
1. No. of ploughing	
Normal	: 4-6
Zero tillage	: Nil
2. Time of sowing	
Grain crop	
Winter	: September—November
Summer	: April—May
Green cobs.	
Winter	: September—October
Summer	: April—May
Fodder	: Any time of the year, provided adequate moisture is available for germination.
3. Method of planting	
Grain crop and green cobs	: Line sowing behind the plough
Fodder	: Broadcasting
4. Spacing	
Grain crop and green cobs	: Line to line 75 cm; plant to plant 25 cm with 1 plant/hill and 50 cm with 2 plants/hill i.e. around 53,000 plants/ha. For early maturing and shorter plant type varieties spacing may be 75 cm x 33cm with 2 plants/hill i.e. around 80,000 plants/ha.
Fodder	: Broadcasting to achieve around 200,000 to 300,000 plants/ha.
5. Varieties	: Sadaf, Sawar-2 and Suwan-1
6. Seed rate	
Grain crop and green cobs.	: 20-30 kg/ha i.e. 50,000 to 80,000 plants/ha.
Fodder	: 70 to 90 kg/ha.
7. Seed treatment	: Before planting 50 ml of Furadon 30%, 2 g of Arasan 75%, and 12 ml of water/kg of seed.
8. Fertilizer	
Grain crop and green cobs	: Cow-dung -5 to 7 tons/ha Urea--260 kg/ha T.S.P.133 kg/ha M.P.--83 kg/ha In case of Sulphur and Zinc deficiency Gypsum-111 kg/ha and Zinc Sulphate-14 kg/ha, respectively.

	Fodder	: Urea—300 kg/ha T.S.P.—133 kg/ha.
9.	Method of fertilizer application	: Split applications into three instalments. One third of N and other fertilizers should be applied at the time of seed-bed preparation. Remaining two-thirds of N should be applied in two instalments: one-third at floral initiations (Knee height stage) and the rest at about one week before silking. In case of dibbling methods of planting, initial dose of fertilizers can be applied in the pits, 10 cm apart from the plants. The second and third doses of N can be broadcast in two instalments as mentioned. For fodder, initial dose of fertilizer can be broadcast at planting and second and third dose can be broadcast at knee height and one week before silking.
10.	Water management	
	Winter	
	Grain crop	: 4 irrigations (at germination, knee height, one week before silking and two weeks after silking.
	Green cobs	: 3 irrigations (at germination, knee height and one week before silking).
	Fodder	: 2 irrigations (at germination and knee height stages).
	Summer	: Ensure good drainage system, so that flood or rain water can not stand more than one day.
11.	Thin	: In case of over-planting thinning should be done in about 2 weeks after germination, when seedlings are 12-15 cm tall.
12.	Earthing up	: At knee height stage.
13.	Weed control	: 2-3 weedings. In case of zero tillage, application of pre-emergence herbicides such as 2, 4-D before planting would be useful.
14.	Insect (earworm)	: 1-2 sprays of contact insecticides such as Carbaryl, Methomyl or Methyl parathion on the green silk at 3-5 days interval.
15.	Harvesting	
	Grain crop	: When plant shows sign of drying, huskcover is completely dry and a black layer forms at the junction of grain and cob.

	Green cobs	: When grains are in milk or dough stage.
	Fodder	: Within a week of silking.
16.	Shelling	: Recommend hand shelling using wire-tongs and manual or mechanical simple maize sheller.
17.	Drying	: Under sun, by natural ventilation, unheated forced air, and heated forced air.
18.	Grain moisture	: 12-14%
19.	Mode of storing	: Shelled grain, whole cobs, and unhusked cobs.
20.	Method of storing	: Air-tight earthen pots, jute sacks or bags, special container made from bamboo, and mechanized wire-house. Ensure low humidity and ambient temperature.
21.	Dry milling	: Burr mills, country dhaki and hammer mills.
22.	Wet milling	: Mechanized wet milling plants.

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Annex: 5.4 Suggestions for a Pamphlet on Maize Extension

GROW MAIZE FOR HIGHER PROFITS

Maize is a high profit crop -- because;

- It yields significantly more than rice and wheat.
- It requires much less water than rice and wheat.
- It can be grown year round.
- It yields valuable fuel in addition to grain.
- It is less vulnerable to disease and field pests.
- It is an excellent source of green fodder for cattle and feed for poultry.
- It brings more taka per acre.

ANNEX: 5.5 MODEL PROMOTIONAL PAMPHLET: CONSUMPTION

EAT MAIZE FOR BETTER NUTRITION

FACTS

- Maize is the staple food in Latin America, some parts of Nepal, India, Pakistan and Southern United States.
- Maize has more energy per unit weight of rice and wheat.
- Unlike wheat and rice, yellow maize can provide much needed vitamin A in good quantity.
- Maize oil is the best edible oil, free of cholesterol.

HOW TO EAT MAIZE

- Mixed with wheat flour in 1:3 ratio, maize produces excellent Chapatis.
- In the form of grits, it can be prepared and eaten in boiled form in the same way as rice. Also can be eaten as Khichuri.
- Biscuits, cakes, peetha and muffins can be made out of maize flour, with or without wheat flour.
- It can be mixed with besan to produce Bada, Pakoda and Piaju.

HOW MUCH TO EAT

- Maize can be eaten in place of rice or wheat, quantity to quantity as a full meal.
- Infants and children can be served a number of preparations made out of maize grits and flour.

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Annex 6.1 Organizations Involved in Maize Promotion in Bangladesh.

Organization		Activity
Government :		
Ministry of Agricultural	:	Administrative
Bangladesh Agricultural Research Council (BARC)	:	Reserach co-ordination
Bangladesh Agricultural Research Institute (BARI)	:	Overall maize improvement and development
Department of Agronomy, Bangladesh Agricultural University (BAU)	:	Agronomic studies
Bangladesh Agricultural Development Corporation (BADC)	:	Seed production and distribution of agricultural inputs.
Directorate of Agricultural Extension (DAE)	:	Extension services
Directorate of Agricultural Marketing (DAM)	:	Marketing and price monitoring
Non-Government :		
International Maize and Wheat Improvement Centre, (CIMMYT), Mexico	:	Germplasm development and improvement, training research scientist
Agricultural Sector Team (AST) of Canada, Dhaka	:	Socio-economic research
Mennonite Central Committee (MCC)	:	Agronomic research
Winrock International	:	Technical assistance
Ford Foundation	:	Financial agency
US Agency for International Development (USAID)	:	Financial agency

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8. LIST OF PEOPLE VISITED

8. List of people visited

Mr. Anisuzzaman
Secretary
Ministry of Agriculture
Govt. of the People's Republic of Bangladesh
Dhaka.

Dr. Kamaluddin Ahmed
Ex-Member-Director (Crops)
BARI, Dhaka, Bangladesh.

Mr. Dabir Uddin Ahmed
Deputy Director
Directorate of Agricultural Marketing
Dhaka, Bangladesh.

Md. Mortuza Ali
Vill. Islampur
Upazila - Syedpur
Dist. Nilphamari.

Mr. Samiul Ahsan
President
Bangladesh Poultry Development Association
Dhaka, Bangladesh.

Dr. Charles Baily
Representative
Ford Foundation
Dhaka, Bangladesh.

Mrs. Rowshan Ara Begum
Assistant Director
Directorate of Social Welfare
Dhaka, Bangladesh.

Mr. Hans Bittmann
Team Leader - Consultant
TCP/BGD/6512, FAO, Dhaka, Bangladesh.

Dr. D. Daugherty
Project Supervisor
Winrock International for Agricultural Development
Dhaka, Bangladesh.

Mr. Giasuddin
Section Chief
Food Planning and Monitoring Unit (FPMU)
Ministry of Food, Dhaka, Bangladesh.

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Plant Breeding Division
BARI, Joydebpur, Gazipur.

Dr. A.K.M. Habibullah
Consultant
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Dr. Ian Darnton - Hill
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Md. Emdad Hossain
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Dist. Nilphamari

Mr. Mosharraf Hossain
Agriculture Officer
Thakurgaon

Md. Selim Hossain
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Mr. Charles Hash
Director
Food and Agriculture Division
USAID, Dhaka, Bangladesh.

Mr. Allan Hurdus
Deputy Director
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USAID, Dhaka, Bangladeh.

Mr. S. M. Jahangir
Food Economist
Food and Agriculture Division
USAID, Dhaka Bangladesh.

Mr. Golam Kabir
Program Specialist
Food and Agriculture Divsion
USAID, Dhaka, Bangladesh.

Mr. Safi Ahmed Khan
Rahman Chemicals
Motijheel C/A, Dhaka, Bangladesh.

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Mr. Ibrahim Khalil
Program Assistant
Food and Agriculture Division
USAID, Dhaka, Bangladesh.

Mr. Lowell E. Lynch
Food for Peace Officer
Food and Agriculture Division
USAID, Dhaka, Bangladesh.

Mr. I. U. Malik
Joint Secretary
Ministry of Food
Dhaka, Bangladesh.

Dr. R. N. Mallick
Consultant
World Bank
Dhaka, Bangladesh.

Dr. M. M. Mia
Director
BINA, Mymensingh.

Dr. Hamid Mia
Member-Director
BARC, Dhaka, Bangladesh.

Dr. Ali Mohammad
Agriculture Sector Team
CIDA, Dhaka, Bangladesh.

Mr. Robert Niven
Agricultural Economic
Food and Agriculture Division
USAID, Dhaka, Bangladesh.

Mr. S. K. Rahman
Rahman Chemicals
Motijheel C/A, Dhaka, Bangladesh.

Mr. Latifur Rahman
Agricultural Project Advisor
Food and Agriculture Division
USAID, Dhaka, Bangladesh.

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Mr. M. Mahbubur Rahman
Manager (Marketing)
Agricultural Services Center Division
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Mr. Atikur Rahman
Deputy Director
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Mr. K. Rushing
Agricultural Development Officer
Food and Agriculture Division
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Dr. L. C. Sikka
Consultant
CIDA, Dhaka, Bangladesh.

Dr. M.A.Q. Shaik
BINA, Mymensingh, Bangladesh.

Md. Sukur Uddin
General Secretary
Stranded Pakistanis General Repatration Committee
Dhaka, Bangladesh.

Mr. M. Moyeen Uddin
Additional Director
Food Crop Wing
Department of Agricultural Extension
Dhaka, Bangladesh.

Ms. Nilufar Zaman
Research Officer
Ministry of Food
Dhaka, Bangladesh.