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Foodgrain Supply, Distribution, and Consumption Policies within a Dual Pricing Mechanism:

A Case Study of Bangladesh

by Raisuddin Ahmed

May 1979

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FOREWORD

Conflict between the short run welfare of poor consumers and agricultural production incentives creates some of the most difficult policy issues facing developing countries. Resulting policy option constraints are particularly severe in very low income countries. The conflict may on the one hand impede the growth in agricultural production essential to improved long term welfare of low income consumers, and on the other hand restrain policies to increase consumption, which in the long run is essential to the success of the measures taken to increase production. The widely observed phenomenon of urban bias in food price policy is itself a product of the nature of low income societies and of this complex conflict.

This research by Raisuddin Ahmed delineates and describes the complex interacting parts of this conflict in Bangladesh, one of the lowest income Third World countries. The study is one of a series being conducted at the International Food Policy Research Institute dealing generally with policies influencing the effective demand for food and specifically with food subsidy policies in South Asia. A study by Shubh Kumar, based on a detailed survey of families in Kerala, India, was published in January 1979. It measured the effect of various food policies on the nutritional status and health of infants. A study by P. S. George, examining historically and in detail the operation of the food distribution program in Kerala, is of particular interest in its treatment of the interaction of distribution and procurement policies.

This study by Raisuddin Ahmed provides valuable information on who benefits from the public distribution, what feasible policy options are available for the rural poor, and the nature of the interaction between the public and market distribution systems which together comprise the dual market mechanism of foodgrain distribution in Bangladesh. The manner of treatment and the types of questions addressed make the study especially valuable to persons operating or contemplating development of large scale food distribution programs.

In the course of the development of the research in this publication, the author and other members of IFPRI's staff participated in a joint IFPRI–World Bank Bangladesh Food Policy Review Mission. In response to a request from the Bangladesh Government, which grew out of recommendations in the mission report, Raisuddin Ahmed worked with the government in the fall of 1978 to help develop the basis for an enlarged government capacity to analyze food policy problems.

A related study on food distribution policies in Sri Lanka is in process at IFPRI. It will also present an overview analysis of food policy in South Asia that will draw on the four specific studies done at the country level. Further, IFPRI will soon initiate an examination of a set of related issues through a collaborative project with the International Rice Research Institute, the International Fertilizer Development Center, and several institutes in Southeast Asia.

John W. Mellor

Washington, D.C.
May 1979

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1

SUMMARY

This study analyzes policies that determine the consumption and distribution of foodgrains in Bangladesh, one of the most densely populated and poorest nations in the world. Domestic production of foodgrains has not only lagged behind growth in demand, it has been highly unstable. Prices consequently fluctuate sharply, and policy makers face the challenge of stabilizing both prices and consumption in the face of highly variable domestic supplies.

The first part of the paper examines the workings of the food system. It evaluates the present status of production, distribution, and consumption, and describes how each component of the system works.

As measured by caloric intake, poverty in Bangladesh is widespread and appears to be increasing. The proportion of "absolutely poor" people—those consuming less than 1,935 calories per capita per day—increased from about 42 to 56 percent of the rural population, and from 25 to 48 percent of city dwellers, from 1963 to 1974. Likewise the incidence of "extreme" poverty—defined as daily consumption of less than 1,720 calories per capita—has expanded from 4 to 29 percent in the countryside, and from 2 to 15 percent of the population in urban areas. And while it is difficult to draw unequivocal conclusions from such a comparison when production is highly variable, other indications suggest also that the country's food problems are growing. To meet the consumption requirements of the population, especially the urban population, the government increasingly has turned to world grain markets for imports to close, or at least reduce, the gap between domestic supply and demand.

The government augments available supplies by selling foodgrains through its public food distribution (rationing) system after importing them on cash, credit, or grant bases. Purchases on credit, especially of grain under U.S. Public Law 480, constitute the largest share. The unit real cost of wheat purchased on credit, including shipping, was from 59 to 68 percent of the cost of cash purchases from 1974-75; for rice, it ranged from 46 to 69 percent of the cash cost. Therefore it is not surprising that estimates based on 1975-76 prices show the government gaining from imports of foodgrains on credit and grant terms, but losing money on cash imports and on grain that is resold after it is domestically procured. On rice, the government gains about Tk 840[1] per ton on credit purchases, Tk 920 per ton on grants. The gain from wheat is about Tk 513 per ton on credit, Tk 918 per ton on grants. Losses range from about Tk 2,565 per ton on cash imports of rice to about Tk 1,188 per ton on cash wheat imports. On domestically procured rice, the loss is about Tk 1,730 per ton.

These figures suggest that increased domestic production advocated to attain national self-sufficiency may in fact cost

[1] The Bangladesh Taka (Tk) was officially valued at 15.46 to the U.S. dollar in July 1976. Unless otherwise specified, ton refers to long ton throughout this study.

the government money if domestic procurement supplants imports under grant and concessional terms. The total budget subsidy on food, primarily as a result of the cost incurred when the government sells grain through public distribution at a lower price than it paid, already accounts for 7 to 13 percent of the total government budget and 21 to 36 percent of the net public revenue. During the 1972-76 period, the subsidy ranged from about Tk 780 million to Tk 1,000 million annually.

With the basic structure outlined, the analysis turns to the interaction of the various elements in the food distribution system. A quantitative framework showing those interrelationships suggests that for a given level of domestic production, imports, and income (and therefore consumption), the government can raise or lower the market price of rice by changing the proportions of public stock allocated to the open market and to rationing. For a given import level, the higher the proportion of rice put through the ration system relative to that sold in the open market, the higher the market price of rice. This effect on market price is larger when public stock releases more rice than wheat; open market sales of wheat would have to be about 42 percent larger than open market sales of rice at prices prevailing during the 1970s to depress market rice prices by the same amount. Therefore the government should close consumption gaps by importing wheat rather than rice if it wants to maintain farmer incentives by minimizing downward pressure on domestic rice prices.

The study uses quantitative relationships to project several probable production and import scenarios for 1980. Results indicate that the target levels of grain consumption (15.5 ounces per capita per day) and prices (averaging Tk 145 per maund)[2] can be attained with a bumper crop of 15 million tons and with imports of about one million tons.

The public food distribution system in Bangladesh supplies foodgrains to several categories of recipients, fixes ration quotas and prices, and issues ration cards. Rations allocated to such groups as government employees, urban residents, and "priority" groups have been much more stable than those for the "modified rationing" group that partly serves the rural poor. Rationing has aided the urban poor quite successfully since without it the consumption levels of the poorest 15 percent of the urban population would have been 15 to 25 percent lower in 1973-74 than they were. Based on 1973-74 data it appears that two thirds of all public foodgrains go to urban consumers, even though only about 9 percent of the national population is urban and the absolute number of "extremely poor" rural residents is about two and a half times the total urban population.

To ameliorate rural poverty, it would be desirable to divert rationed foodgrains from urban to rural areas, although the political feasibility of such a proposal is doubtful. An extended rural rationing scheme to increase average consumption of the poorest 26 percent of the rural population by 10 to 15 percent would cost about Tk 3.5 to 4 billion.[3] Basing such a scheme entirely on foreign foodgrain aid would depress domestic prices 10 to 27 percent and would discourage local production. To simultaneously maintain the domestic price, 37 to 49 percent of foodgrains for the expanded scheme would have to be supplied through domestic procurement, primarily of rice. Compared with rice, wheat has a lower

[2] One maund is equivalent to 82.2 pounds.

[3] This is equivalent to about 50 to 60 percent of the current budgetary expenditure and 71 to 83 percent of the net government revenue in 1975-76.

depressing effect on market rice price; but too much substitution of wheat for rice might disrupt the small wheat market.

A side effect of increasing the supply of ration foodgrains and/or lowering ration prices is that it generates additional demand for other commodities, including nongrain foods, at an even faster proportionate rate than it increases foodgrain consumption. Therefore policies designed to increase supplies of cheap nongrain foods, along with the public distribution of foodgrains, will assist in improving the overall nutritional status of the poor.

With a resource constraint for expanded rationing, the government can aid consumption of the poor by selling on the open market. For a given drop in foodgrain prices, consumption levels of the poor increase faster than those of the rich, suggesting that in some cases open market sale of foodgrains from public stocks would be desirable for the rural poor.[4] Such sales might best be restricted to the lean months of the crop season, and could probably be conducted with a feasible stock level. However, caution is warranted to avoid damaging the private grain trade.

The government obtains grain through imports and domestic procurement. Domestic procurement—voluntary or compulsory sale of foodgrains by producers and market intermediaries to the government—exceeded 1.4 percent of gross grain production only in 1975-76, when the government procured about 3.5 percent. Those percentages appear more substantial when compared with the 18 to 28 percent of total production marketed.

Production level is an important determinant of the level of procurement. The elasticity of procurement with respect to production was calculated at 1.86, meaning that a 10 percent increase in production would raise procurement 18.6 percent. The procurement of the main *aman* rice crop is expected to continue to provide price support for all rice crops. The difference between the *aman* harvest season price and the average annual price is determined by total rice production, ration distribution during this season, production and prices of jute, and the level of nonagricultural activities. An understanding of the interaction of these components can provide policy makers with a basis for advance planning of procurement, enabling them to use special income-generating programs to support prices in good harvest years.

An upper limit to rice prices is required to maintain a desirable balance of acreage under rice and jute (this balance would be tilted away from jute if rice prices climbed higher than approximately Tk 145 per maund, causing farmers to shift jute acreage to rice production). At the other extreme, available data on the cost of production of rice indicate that the procurement price of Tk 74 per maund of paddy provides sufficient incentive in normal crop years to most farmers, although it is less attractive to tenant farmers. The relationship between procurement price and fertilizer price also shows the presence of adequate incentives for fertilizer use.

Reducing seasonal fluctuations in foodgrain prices would be desirable for stabilizing consumption as well as for maintaining producer incentives. During the lean period of the year, consumption of all foods falls by an average of about 20 percent, while rice prices may climb as much as 60 percent above their harvest season lows. Harvest prices can be raised and peak season prices lowered by procurement and open market sales without

[4] A more definitive statement requires detailed knowledge of the rural labor market and the way the rice price affects the incomes of various groups in the rural sector. Research to clarify some of these relationships is currently underway at IFPRI.

affecting the annual average price. However, adhering to a price band of 8 to 12 percent of the average will provide a safeguard to keep government from substituting public for private grain.

This paper also examines the relative efficiency of price support and fertilizer subsidy policies to increase rice production by half a million tons. Results show that there are substantial social benefits to producers under both programs, but that the net social benefit of the price support program is negative. Low price elasticity of rice production reflecting mainly the effect of substitution of rice for jute where there are land constraints and a high degree of self-sufficiency in fertilizer production contribute to the relative superiority of fertilizer subsidy over price support policy. Distributional implications of the two policies also appear to favor fertilizer subsidy policies.

Since low income and lack of available foodgrains seriously constrain the levels of consumption of the poor, growth of output and income for improved calorie intake is of crucial importance in Bangladesh. Distribution policies provide two options for improvement of this situation.

Appropriate distribution policies can cause an increase in consumption among the rural poor through an extended rural rationing scheme. To be successful, such a scheme would require additional foreign aid and a substantial reduction in urban rationing, neither of which appears likely. A smaller program would be inadequate and operationally inefficient, so the possibilities under this type of policy appear extremely limited.

A second set of distribution policy options would concentrate on better management of the existing system, with provision for marginal improvement in consumption of the poor. As indicated in the text, management of policies relating to rationing, open market sale, procurement, and the level and composition of imports would still provide considerable help to consumers and incentive to producers. The quantitative framework developed in this paper can be operationally useful, especially if the government established a food policy unit staffed by analytically capable researchers within the relevant government ministry.

2

INTRODUCTION

Attempts to resolve Bangladesh's food problem have drawn worldwide attention and generous international assistance. Yet the problem persists. Knowledge of how the food distribution system is managed, how policies are designed, and what happens ultimately to consumers in the system is therefore important to both national and international policy makers.

With this in mind, the study was designed to describe the role of public distribution in Bangladesh, to identify groups benefitting from the public foodgrain distribution program and assess their income and nutritional status, to assess the cost of the public foodgrain distribution program, to show the interrelationships between the public and market distribution systems and deduce their policy implications, and to evaluate the performance of domestic procurement of foodgrains in general and the relative advantage of price support versus fertilizer subsidy policies in particular.

The study takes a systems approach to food distribution, although it does not employ simulation as such. In this approach, the food distribution system consists of status variables, which provide a picture of the characteristics and environment of the system; policy variables, which represent government action to achieve certain objectives; and the outcome or objectives that the system is designed to fulfill.

Some of these variables are controllable; many are interrelated. Therefore, the classification should be viewed as part of a larger system: the foodgrain distribution system in the economy of Bangladesh. With this qualification, the foodgrain distribution system comprises the following variables:

status variables

1. supply—domestic production and imports
2. stability characteristics of supply
3. market and public distribution structures
4. marketed surplus, marketing margins, and costs
5. per capita income and its distribution

policy variables

1. ration distribution
   a. ration quota, quantity, and coverage
   b. ration composition—rice and wheat
   c. ration price
2. domestic procurement
   a. procurement quantity and options
   b. procurement price
3. open market sale from public stock

outcome variables

1. consumption (nutritional status) and its distribution
2. market price of rice and its stability.

To some extent it can be argued that imports, which have been listed as a status variable, should be treated as a policy variable because the government controls imports, which directly affect consumption and prices. But while it is easy to restrict imports, foreign exchange constraints make this method of augmenting supply much less reliable. In the chronically food deficit economy of Bangladesh,

policy decisions on imports have tended to be residual as a result of the availability of foreign exchange and concessional sales from foreign donors. The foreign exchange constraint is not absolute, but once government sets its consumption and price targets, import requirements are also simultaneously determined, at least within a narrow range of variability.[5]

Chapter 3 examines the workings of foodgrain supply, distribution, and consumption historically and at present. Chapter 4 takes the information on the operation of the food system, analyzes the interrelationships of its various components, and projects several possible production and import scenarios for 1980.

The analysis then turns to the effect government actions have on the system. Chapter 5 explains how public food distribution changes the consumption levels of various income groups, and Chapter 6 examines the role government procurement plays in the wide seasonal fluctuation of domestic rice prices. Finally, the paper explores two alternative policies to augment aggregate supply by increasing production.

[5] Chapter 4 analyzes the implications of using imports as a policy variable.

3

FOODGRAIN SUPPLY, CONSUMPTION, AND DISTRIBUTION

Foodgrains in Bangladesh consist of rice, wheat, and some minor cereals such as millet and barley. On the average, rice accounted for 98.5 percent of total foodgrain production from 1969 to 1976. The proportion of rice in total consumption during the same period was somewhat lower, about 88 percent, implying proportionately larger imports of wheat. Rice and wheat make up about 99.6 percent of total foodgrain production as well as consumption.

Rice production grew by only 2.06 percent annually from 1964 to 1976, even excluding the abnormal years from 1971 to 1973. If these two years are included the growth rate was only 1.17 percent. Population grew at an estimated 2.6 to 2.8 percent annually from 1961 to 1974.

In addition to growing slowly, domestic rice production has been unstable. It fell by 10 to 15 percent of its five-year average about once every four years between 1960 and 1976. This instability underlines the importance of food policies both to build up and manage a security stock, and to increase production.

Foodgrain imports from 1965 to 1975 increased at an annual rate of about 6 percent, rising from about one million tons in the midsixties to about 1.5 million tons in 1975-76, one of the best crop years. Imports reached a high of about 2.8 million tons in 1972-73, when natural calamities aggravated existing economic problems caused by war. Rice as a percentage of total foodgrain imports has been declining. The rice-wheat import ratio generally falls in years of scarcity and rises in good crop years.

Net Availability for Consumption

Net aggregate foodgrain availability for consumption from 1965 to 1976 appears in Table 1.[6] Derived from these assumptions, foodgrain availability in 1973-74 was 12.3 million tons. However, household survey figures of actual per capita consumption and population figures for 1973-74 indicate that total estimated consumption of foodgrains for 1973-74 was 12.5 million tons.

Estimated per capita consumption of foodgrains varies from 14 to 16.1 ounces per day. In comparison, annual variations are largely determined by the fluctuations in domestic production, although imports have some stabilizing effect. The variation around the domestic production trend line, measured by the standard error, is about 11 percent; variation is 7 percent around the consumption trend.

Disaggregated Consumption and Nutritional Status

Consumption of foodgrains and the estimated levels of calorie intake by people in various income groups are presented

[6] The estimates are based on the assumptions that there were no changes in privately held stocks and that seed, feed, and wastage take about 10 percent of gross production. The 10 percent figure is based on Bangladesh Bureau of Statistics, *Master Survey of Agriculture 1963-64, 1964-65*, Second Round (Dacca, 1976). No hard data are available on stock in private hands, although the Master Surveys of Agriculture of 1963-64 and 1967-68 indicate that stocks held by farmers varied from 2.5 to 3.8 percent of production.

Table 1—Availability of foodgrains for consumption, 1965-66 to 1975-76

Year	From Domestic Sources[a]		Imports	Ration Offtake	Internal Procurement	Net Availability for Consumption[b]	
	Total	Per Capita Per Day				Total	Per Capita Per Day
	(1000 tons)	(ounces)	(1000 tons)	(1000 tons)	(1000 tons)	(1000 tons)	(ounces)
1965-66	9,329	14.2	923	986	93	10,222	15.5
1966-67	8,526	12.6	1,100	958	8	9,476	14.0
1967-68	9,943	12.6	1,100	958	8	9,476	14.0
1968-69	10,127	14.3	1,019	887	22	10,808	15.5
1969-70	10,731	14.1	119	944	9	11,062	15.4
1970-71	9,972	14.6	1,547	1,169	9	11,891	16.1
1971-72[c]	8,798	11.9	1,668	1,735	—	10,533	14.2
1972-73	9,018	12.0	2,782	2,618	52	11,584	15.3
1973-74	10,646	13.7	1,651	1,727	71	12,302	15.9
1974-75	10,102	12.7	2,260	1,764	138	11,728	14.7
1975-76	11,511	14.1	1,440	1,676	420	12,767	15.6

Source: Based on data from unpublished documents provided by the Bangladesh Ministries of Agriculture and Food, Dacca.

[a] Gross production minus 10 percent for seed, feed, and waste.

[b] Total consumption is equivalent to gross production minus 10 percent internal procurement plus offtake from rationing.

[c] The statistics for the war year 1971-72 are highly controversial.

in Table 2. The average per capita calorie intake in 1973-74 was 1,948. It was estimated converting the food intake recorded in the 1973-74 Household Survey by the standard calorie conversion factor for Indian foods.[7] About 55 percent of the population falls below this average energy intake level.

On the average, foodgrains contribute about 82 percent of the total calorie intake of Bangladesh's population. This contribution gradually decreases as incomes increase. The calorie intake of the urban poor is substantially higher than that of the rural poor, and the calorie intake of the urban rich is slightly lower than that of the rural rich.[8]

Consumption varies during the year as well. Preliminary results of the 1975-76 Nutrition Survey[9] in three districts of Bangladesh indicate that September-November, the time before the harvest of the *aman* crop, is the leanest period of consumption. At this time, the propor-

[7] C. Gopalan, et al. *Nutritive Values of Indian Foods* (Hyderabad: National Institute of Nutrition, 1974).

[8] The energy intake of the bottom 10 percent of the urban population ranges from 1,285 to 1,643 calories, while that of the top 10 percent ranges from 2,283 to 2,577 calories. A similar comparison indicates that the energy intake ranges from 880 to 1,361 calories for the bottom 10 percent of the rural population; 2,356 to 2,652 calories for the top 10 percent. See Bangladesh, Bureau of Statistics, *A Report on the Household Expenditure Survey of Bangladesh, 1973-74* (Dacca, 1978).

[9] Bangladesh, Institute of Nutrition and Food Science, *Preliminary Report of the 1975-76 Nutrition Survey* (Dacca: Dacca University, 1976).

Table 2—Energy intake and consumption of foodgrains by income, 1973-74

Income Group	Consumption Per Capita Per Day	Total Energy Intake Per Capita Per Day	Energy from Foodgrain as a Percent of Total	Percentage of Population Cumulative
(Tk/month)	(ounces)	(calories)		
Less than 100	7.52	885	83.3	0.81
100-149	9.72	1,141	83.9	3.83
150-199	11.81	1,362	85.5	9.43
200-249	13.45	1,555	85.3	16.73
250-299	14.21	1,677	83.5	25.02
300-399	15.59	1,815	84.7	41.18
400-499	16.30	1,929	83.3	54.49
500-749	17.50	2,088	82.6	75.82
750-999	18.60	2,299	79.8	86.33
1,000-1,499	19.48	2,427	79.1	95.08
1,500-1,999	20.48	2,616	77.2	97.46
2,000 and above	19.54	2,608	73.9	100.00
All Groups	16.15	1,948	81.7	—

Source: Computed from data from Bangladesh, Bureau of Statistics, *A Report of the Household Expenditure Survey of Bangladesh 1973-74* (Dacca, 1978).

tion of cereals in the total food intake increases in most areas as substitutes become scarce. In general, nongrain foods like vegetables and root crops are plentiful when cereals are plentiful, so average food consumption falls by about 20 percent during the lean period. Lean period consumption shows a similar drop when estimated for 1973-74 by using the price elasticities of demand for foodgrains for various income classes and the fluctuations of prices between the average and the lean periods.

Changes in Poverty Over Time

A. R. Khan measured poverty in rural Bangladesh according to two definitions. He defined extreme poverty as consumption of less than 1,720 calories per day and absolute poverty as consumption of less than 1,935 calories per day.[10] Khan's analysis of the 1963-64 household survey data shows that about 52 percent of the households accounting for 40 percent of the rural population were absolutely poor and 10 percent of the households accounting for 5 percent of the rural population were extremely poor.[11]

The 1973-74 survey provides detailed data for computing calorie consumption by income group in rural and urban areas. Using these relationships and the 1963-64 Household Survey data, it is possible to estimate the calorie consumption by

[10] Azizur R. Khan, "Poverty and Inequality in Rural Bangladesh," Rural Employment Program Research Working Paper (Geneva: International Labor Organization, 1976).

[11] Khan identified an income level at 1963-64 prices that provides a basket of foods, which can be converted into a calorie level. Through this calorie income relationship he worked out the calorie levels of various income groups for the 1963-64 Household Survey results.

expenditure groups in 1963-64 and compare the extent of poverty then with the more recent data. This involves pricing the 1963-64 household expenditures by various groups at 1973-74 prices, using a cost of living index for workers[12] and assuming that the consumption pattern did not change. This appears reasonable because foodgrains account for more than 80 percent of the total calorie intake in Bangladesh.

Taking the 1973-74 survey data, calorie income relationships were estimated. These were:

$$KR = -2{,}899.2 + 1{,}117 \log YR; \quad (1)$$
(t values) (−13.854) (22,995)

$$\bar{R}^2 = 0.98, \text{ and}$$

$$KU = -1{,}453.6 + 766.62 \log YU; \quad (2)$$
(t values) (−10.867) (25.117)

$$\bar{R}^2 = 0.98,$$

where

KR = per capita calories per day in rural areas,
YR = per capita total household expenditure (takas per month) in rural areas,
KU = per capita calories per day in urban areas, and
YU = per capita total household expenditure (takas per month) in urban areas.

Using the poverty lines defined by Khan, the extent of poverty in 1963-64 and 1973-74 in both urban and rural areas, as estimated in this study, is presented in Table 3.

The analysis indicates that to provide a calorie level of 1,935, per capita disposable income for consumption would have to be Tk 76 in rural areas and Tk 83 in urban areas, at 1973-74 prices. Results show further that the incidence of poverty is greater in rural areas than in urban and that poverty has substantially increased during the last decade. However, the conclusion has to be viewed cautiously because a comparison at two points in time may reflect a yearly fluctuation rather than a trend. Nevertheless, other evidence, as presented in Khan's study, lends strong support to this conclusion.

Foodgrain Distribution System

The foodgrain distribution system in Bangladesh comprises two subsystems: market distribution and public distribution. Foodgrains distributed through the open market are those from domestic production remaining after subsistence consumption by producers and internal procurement by the government. The primary sources of supply for the public

Table 3—Incidence of poverty, 1963-64, 1973-74

(Percentage of Population)

Year	Absolutely Poor[a]		Extremely Poor[b]	
	Rural	Urban	Rural	Urban
1963-64	41.6	24.6	4.4	2.1
1973-74	56.0	47.9	29.1	15.3

[a] Per capita calorie intake is less than 1,935 calories.
[b] Per capita calorie intake is less than 1,720 calories.

[12] This index was taken from Bangladesh Bureau of Statistics, *Statistical Yearbook of Bangladesh, 1975* (Dacca, 1976).

distribution system are internal procurement by the government and imports. The government has a complete monoply on foodgrain imports.

Market Distribution

Many small-scale intermediaries are involved in moving rice from producers to consumers. According to the Department of Marketing, there are about 600 primary markets in the rural areas and 300 secondary markets in commercial centers scattered throughout the country. The 1963-64 and the 1967-68 Master Surveys of Agriculture indicate that growers make about 61 percent of their total sales in primary markets, 28 percent on the farm yard to itinerant traders, and 11 percent in secondary markets, which serve as exchange centers of foodgrains among market intermediaries.

The principal modes of transportation of foodgrains from growers to markets are headloads, boats, and bullock carts. Boats and trucks carry interdistrict and intermarket shipments; use of the railway system is largely limited to public foodgrains.

Information on marketed quantity of foodgrains is outdated and scanty. The Agricultural Master Surveys between 1953 and 1968 show that the marketed quantity of foodgrains varied from 12.2 to 14.2 percent of gross production (including small stocks) during these years.[13] Discussions with the Marketing Department suggested that the proportions of rice marketed in recent years had been substantially higher.

Though there is much circumstantial evidence indicating an increasing marketed quantity, direct evidence is limited. A survey of 3,000 farms in all districts of Bangladesh during *aman*[14] 1973-74 indicated that about 33 percent of the *aman* paddy was marketed in that year.[15] *Aman* rice constitutes about 55 percent of total rice production in most years. Limited information on market arrivals recorded by the Agriculture Marketing Department indicates that the weighted average marketed quantity of rice is about 30 percent.

An indirect estimate of marketed quantity for 1973-74 based on the Household Survey data is 24.5 percent of gross rice production, assuming that all urban and nonfarm rural people have to buy their entire consumption requirement[16] and that a segment of farmers are also net buyers of foodgrains.

Wholesale and retail prices of medium quality rice over a long period are shown in Table 4. Until 1969-70, retail prices ranged from 7 to 9 percent above the wholesale price. This margin increased to about 11 percent of the wholesale price during the postliberation period, probably because of the general disorganization of the economy after 1970-71.

Apart from dramatic swings, real rice prices increased moderately during the sixties and declined during the first few years of the seventies. In 1974-75, the famine year in Bangladesh, prices increased to record levels before retreating to their 1969-70 level the following year.

The spread between producer price and retail price measures distribution cost, including the profit of the market functionaries. The Department of Marketing conducted two studies which found that the marketing margin varies from 23 to 25 percent of the retail price. Producers

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[13] Bangladesh, Bureau of Statistics, *Master Survey of Agriculture*, Second Round; and Bangladesh, Bureau of Statistics, *Master Survey of Agriculture 1967-68*, Seventh Round (Dacca, 1969).

[14] Bangladesh has three crop seasons named for the main rice crops. *Aman* falls between July and December, *Boro* falls between December and April, and *Aus* falls between April and July.

[15] Bangladesh, Department of Agricultural Marketing. "Survey on Paddy Sales in the *Aman* Season of 1973-74," Dacca, 1974. (Mimeographed.)

[16] Supplies through public distribution from import sources are excluded.

Table 4—Wholesale and retail prices of medium quality rice, 1960-61 to 1975-76[a]

Year	Wholesale	Retail	Retail as Percentage of Wholesale	Wholesale Price Index	Retail Price Index	Nonrice General Price Index[b]	Annual Fluctuation of Retail Price
	(Tk/maund)			(1969-70 = 100)			(percent)
1960-61	27.15	29.30	107.92	64.95	65.43	76.21	—
1961-62	28.08	30.21	107.58	67.18	67.46	79.27	+ 3.1
1962-63	29.98	30.22	107.47	71.72	71.95	75.92	+ 6.7
1963-64	27.07	28.96	106.98	64.76	64.67	76.00	− 10.1
1964-65	27.51	29.80	108.32	65.81	66.55	85.98	+ 2.9
1965-66	33.53	35.95	107.21	80.21	80.28	89.40	+ 20.6
1966-67	42.41	46.10	108.70	101.46	102.95	97.73	+ 28.2
1967-68	39.29	42.50	108.17	94.00	94.91	89.03	− 7.8
1968-69	42.70	46.23	108.27	102.15	103.24	96.94	+ 8.8
1969-70	41.80	44.78	107.13	100.00	100.00	100.00	− 3.1
1970-71	41.48	45.30	109.21	99.23	101.16	110.76	+ 1.2
1971-72	51.40	57.10	111.09	122.97	127.51	n.a.	+ 26.0
1972-73	80.63	89.60	111.12	192.90	200.09	268.44	+ 56.9
1973-74	108.37	120.50	111.19	259.26	269.09	330.87	+ 34.5
1974-75	226.45	251.67	111.14	541.75	562.01	402.89	+108.9
1975-76	140.33	153.83	109.62	335.72	343.52	338.87	− 38.9

Source: Data up to 1970-71: M. Alamgir, and L.J.J.B. Berlage, "Foodgrain (Rice and Wheat) Demand, Import and Price Policy for Bangladesh," *Bangladesh Economic Review* 1 (January 1973): 25-58. Remaining figures based on data from various unpublished documents provided by the Bangladesh Ministry of Food and Bureau of Statistics.

[a] Prices represent averages of Dacca, Chittagong, Rajshahi, and Khulna.

[b] Nonrice general price index is computed from the equation:
GPI = W_1 (rice price index) + W_2 (nonrice price index), where W_1 is the weight of rice in gross domestic product (0.37), and W_2 is 0.63.

thus receive about 75 percent of the retail price.[17]

Public Distribution

The major objective of the food rationing system when it was first begun in 1943 was to strengthen the war efforts in India, with particular emphasis on Bengal since it was a province in the front line of war. Providing food to city people was consistent with this general objective. Despite the subsequent changes in political systems in the country, no major deviation is observed in the urban bias of public foodgrain distribution.[18] Urban rationing was and continues to be a political necessity, contributing to stability and thus to economic growth and development.

The system is administered through the Ministry of Food, with the Secretary of Food as its administrative head. The Secretary initiates the formulation of policies and maintains overall supervision of

[17] Shamsul M. Islam, "Agricultural Marketing in Bangladesh," research report of the Economic and Social Commission for Asia and the Pacific, Bangkok, 1975. (Mimeographed.)

[18] Henry Knight, *Food Administration in India, 1937-47* (Stanford: Stanford University Press, 1954).

the system, but lacks access to a specialized government organization that can provide analytical support in formulation of food policies. Instead, the policy formulation process involves consultation with other ministries through an ad hoc Food Policy Committee.

The system is managed by the Director-General of Food, assisted by four directors for four functional lines. Private food dealers licensed by the government distribute foodgrains to consumers with ration cards.

Ration foodgrain price is determined by the interaction of the pressure of ration receivers for a lower price, the government's budgetary burden on subsidy, and the political motivation of the leaders in power. Generally, the pressure from consumers to hold down the ration price mounts in inflationary times. The net result has been that ration prices have always lagged behind market prices. Table 5 shows that average ration prices of rice were about 68 percent of the market prices of medium quality rice during the 1960s, and almost half of that for the early 1970s. Ration prices were adjusted upward during 1973-76, but this upward adjustment could not match the increase in market prices. By 1976, however, ration prices were about 60 percent of the market price of rice.

The ration quota, the amount of subsidized grain consumers receive, is not based on income. Although the total cereal quota does not change very significantly or often, the mix of rice and wheat does change frequently. These changes are made quite arbitrarily and depend

Table 5— Prices of ration foodgrains and foodgrains in the open market, 1965-66 to 1975-76

	Rice Price			Wheat Price		
Year	Ration	Open Market[b]	Ration Price as Percentage of Market Price	Ration	Open Market	Ration Price as Percentage of Market Price
	(Tk/maund)			(Tk/maund)		
1965-66	26.13	35.95	72.68	13.53	n.a.	—
1966-67	28.22	46.10	61.21	18.40	n.a.	—
1967-68	30.17	42.50	70.99	20.66	n.a.	—
1968-69	30.80	46.23	66.62	20.38	n.a.	—
1969-70	30.40	44.78	67.89	19.80	n.a.	—
1970-71	30.00	45.30	66.23	20.80	n.a.	—
1971-72	30.00	57.10	52.54	20.80	n.a.	—
1972-73	35.00[a]	89.60	39.06	25.00	61.80	40.45
1973-74	45.00[a]	102.60	37.34	30.00	73.15	41.00
1974-75	60.00	251.67	23.84	50.00	171.14	29.22
1975-76	80.00[a]	153.83	52.00	60.00	99.10	60.54

Sources: Ration prices from the Bangladesh Department of Food; rice prices from the Bangladesh Bureau of Statistics; and wheat prices from the Bangladesh Agricultural Marketing Department.

[a] Weighted average of the year, because a price change was made within the year. The latest 1975-76 price was Tk 90 per maund for rice and Tk 70 per maund of wheat.

[b] Retail prices of medium quality rice. The price of coarse quality rice would be comparable with ration price. But time series on coarse quality rice prices are not available. A number of year's prices indicate that, on average, prices of coarse rice are about 8.5 percent lower than the medium quality rice.

on the availability of rice and wheat.

During the last four years, the average amount of rice received per cardholder per week has been about 6.15 pounds, which provides an energy equivalent of 1,390 calories per adult per day. Assuming that a minimum calorie requirement per adult per day is 1,950, 6.15 pounds of foodgrains per week provide 71 percent of the minimum energy requirement.

Foodgrains are distributed through the rationing system in Bangladesh according to seven categories: statutory, modified, priority, civil government, large industry, mill, and relief. Statutory groups receive public foodgrains through a legal obligation that the government has to provide rationing in certain geographical areas (usually urban). Modified rationing occurs on a more arbitrary basis as a result of administrative orders and is often politically motivated. The priority category includes prison, police, and hospital personnel; and the civil government category includes all nonmilitary government employees. Some private and all government flour mills receive rationed grain which is then processed and distributed to bakeries. Grain distributed in the relief category is meant to provide immediate aid to people affected by natural calamities, and thus is not a regular source of subsidized food.

Dealers in the statutory ration areas have well-established ration shops. Under modified rationing, particularly in rural areas, the locally elected union councils or their appointees serve as dealers. For a number of reasons, the ration shops in the modified rationing areas are not as stable, adequate in number, or as businesslike as those in the statutory rationing areas. Table 6 presents the share each category has in public foodgrain distribution.

Cost of Public Distribution of Foodgrains

The procurement cost of imported foodgrains depends on world prices at the time of purchase, financial arrangements, and the country of origin. Bangladesh has been importing foodgrains in recent

Table 6—Public distribution of foodgrains under various categories, 1973-74 and 1974-75

Category	1973-74		1974-75	
	Quantity	Share of the Total	Quantity	Share of the Total
	(1,000 tons)	(percent)	(1,000 tons)	(percent)
Statutory	502.0	29.0	470.5	27.1
Modified	777.0	45.0	578.0	33.2
Priority	104.0	6.0	105.0	6.0
Government employees	187.0	10.8	194.0	11.1
Large industrial employers	46.0	2.7	90.5	5.2
Mills	60.0	3.5	130.6	7.5
Relief	52.0	3.0	173.0	9.9
Total	1,728.0	100.0	1,741.6	100.0

Source: Based on data from unpublished documents provided by the Bangladesh Ministry of Food.

years through cash purchases, purchases on credit, and grants. Imports under cash purchases declined during the last four years. Credit imports increased sharply and by 1975-76 reached about 65 percent of the total value of foodgrain imports. The proportion of grant imports was about 45 percent of total imports during 1972-73, 1973-74, and 1974-75, and then declined to about 26 percent in 1975-76, the first good crop year after a series of crisis years. Title I of the U.S. Agricultural Trade and Development Assistance Act of 1954, as amended (Public Law 480), is the largest source of imports under a credit arrangement.[19] Although the arrangement started only in 1973-74, by 1975-76 about 94 percent of all credit imports came from Public Law 480, Title I. Surprisingly, the availability of Public Law 480, Title II, foodgrains for Bangladesh was almost nil during the same period. Most of the grant foodgrains imported during the postliberation crisis period were provided by the EEC countries, Canada, Australia, and Japan.

Cost of Imports Through Cash Versus Credit

Most of the foodgrains distributed by the government are imported. To evaluate the real cost of importing foodgrains involves considering the present cost of imports under credit arrangements and the real cost of foreign exchange involved in cash purchases and future obligations of payment for the credit purchases. In this study the importation of grain under U.S. Public Law 480, Title I, was taken as the representative case for credit purchases. Under this program, credit is repayable in dollars within forty years with a grace period of 10 years. The interest rate is 2 percent during the grace period, and 3 percent during the principal repayment period.

The discounted present cost of the loan in this situation would consist of the present value of interest payments during the repayment period and the present value of the future repayment of principal. It is assumed that the principal is repaid in equal installments. Two discount rates, 0.08 and 0.10, are used as social rates of time preference.

The resulting estimates show that the real cost of wheat imports on credit, excluding shipping, varied between 31 and 43 percent (depending on discount rates) of the cost of cash purchases in the years between 1974 and 1976. In the case of rice, the real cost of credit purchases varied between 41 and 52 percent of the real cost of cash purchases in 1975-76.

When shipping costs are included, the real cost of credit relative to cash purchases changes substantially. The real cost of importing wheat on credit in this case was between 59 and 68 percent of the cost under cash purchases in 1974-75 and 1975-76. For rice imports, inclusion of shipping cost makes the real cost of credit purchases vary between 46 and 69 percent of the real cost under cash purchases. Importing wheat from Australia and rice from Burma and Thailand reduces shipping costs to about half the cost of shipping under credit or cash purchases from the United States. Under Public Law 480, Title I, at least 50 percent of the foodgrains must be carried by U.S. flagships.[20]

Budgetary Subsidy

The impact of foodgrain imports on public revenue and expenditure flows can be evaluated by calculating the budgetary subsidy—the net gain or loss to the government treasury in the current

[19] Title I of Public Law 480 pertains to the sale of U.S. food through long-term credit agreements. Title II pertains to U.S. food donations.

[20] Costs on U.S. ships when compared with ships from other countries is 200 to 250 percent higher in the case of wheat, and 150 to 160 percent higher in the case of rice.

year as a result of the purchase and subsequent resale of foodgrains. The first set of these estimates takes the per unit estimated cost and the cost to the government but does not include any principal payment for credit purchases and does not incorporate shadow prices of foreign exchange. The second set provides the actual total government budgetary expenditures and receipts on foodgrain account.

Table 7 presents the first set of budgetary subsidies estimated per maund of foodgrains. The government treasury gains when it imports foodgrains under credit and grant terms, but loses money on cash imports and domestic procurement.

The second set of estimates, actual budgetary expenditure and revenue on food account, provide the total picture as recorded in budgetary documents and includes costs of domestic procurement (see Table 8). Because detailed data underlying these costs are not available, caution is warranted in drawing conclusions. Even though very little grain was imported for cash payments in 1975-76, the table shows a budget subsidy of Tk 1,006 million. One reason for this large subsidy is the large quantities of foodgrains (about 420,000 tons) procured internally that year.

Table 8 also shows the burden of the public foodgrain distribution program on the financial resources of the government. Although foodgrain imports under credit and grant generate revenue, such sources of revenue are not sufficient to produce an overall net surplus on the food account. On the contrary, if there were no subsidy on foodgrains, development expenditure could be increased by 12 to 30 percent. For example, the Tk 1,006 million spent on food subsidy in 1975-76 could provide 100 percent subsidy on an additional 300,000 tons of fertilizer, which would allow farmers to increase production of cleaned rice by about one million tons, about 8 percent more than total production in 1975-76. This is the nature and magnitude of the trade-off between supporting consumption of target groups and increasing domestic production. This concept will be discussed more fully in Chapter 7.

Table 7—Estimated government cost of rice and wheat imports, by category, 1975-76

Category	Full Value	Current Cost to the Government	Sale Proceeds	Budgetary Subsidy[a]
		(Tk/maund)		
Rice (cash import)	181.94	181.94	87	−94.94
Rice (credit import)	215.85[b]	56.23	87	+30.77
Rice (grant import)[c]	— [d]	20.00	70	+50.00
Wheat (cash import)	110.69	110.69	67	−43.69
Wheat (credit import)	132.05[b]	47.97	67	+19.03
Wheat (grant import)[c]	— [d]	20.00	54	+34.00
Rice procured internally	151.43	151.43	87	−64.43

[a] A negative sign denotes transfer to consumers; a positive sign indicates gains to the treasury.

[b] Includes interest on f.o.b. value at 2 percent which is the interest rate during the grace periods.

[c] 20 percent of total distribution was nonpriced distribution.

[d] Cost not reported.

Table 8—Foodgrain expenditures and receipts and their position in government budgets, 1972-73 to 1975-76

Item	1972-73	1973-74	1974-75	1975-76
		(million Tk)		
Expenditure on food account[a]	1,408	1,683	3,072	3,201
Receipt from public sales of foodgrains	625	720	2,156	2,195
Subsidy transfer	783	963	916	1,006
		(percent)		
Subsidy as a proportion of food expenditure	56	57	30	31
Subsidy as a proportion of total government budget[b]	11.4	12.9	8.4	6.6
Subsidy as a proportion of public development expenditure	19.7	31.6	17.4	11.8
Subsidy as a proportion of public current expenditure	26.9	21.8	16.2	14.7
Food subsidy as a proportion of net tax revenue[c]	36	33	24	21

Source: Computed with data provided by the Bangladesh Ministry of Finance.

[a] Government revenue does not include food sales. Actual expenditure does not include full value of foodgrains received under credit and grant.

[b] Total government budget is the sum of the development and the revenue (current) budget.

[c] Net tax revenue is equal to total tax revenue minus tax payment by the government and public corporations (mainly public payment of custom duties).

4

INTERRELATIONS OF PUBLIC AND MARKET DISTRIBUTION VARIABLES

As outlined in Chapter 3, the forces that influence the demand for and supply of foodgrains in Bangladesh are resolved through two exchange subsystems: open market sale and public rationing. This chapter will quantitatively examine how those forces interact and the information will be used to develop several scenarios to project possible levels of future consumption, imports, and foodgrain price levels.

A Framework

The following framework was developed to show the interrelationships among domestic production, imports, procurement, ration distribution, income, open market sales, consumption, and market prices. Because these relationships are based on annual averages, they are not relevant for seasonal and disaggregated problems.

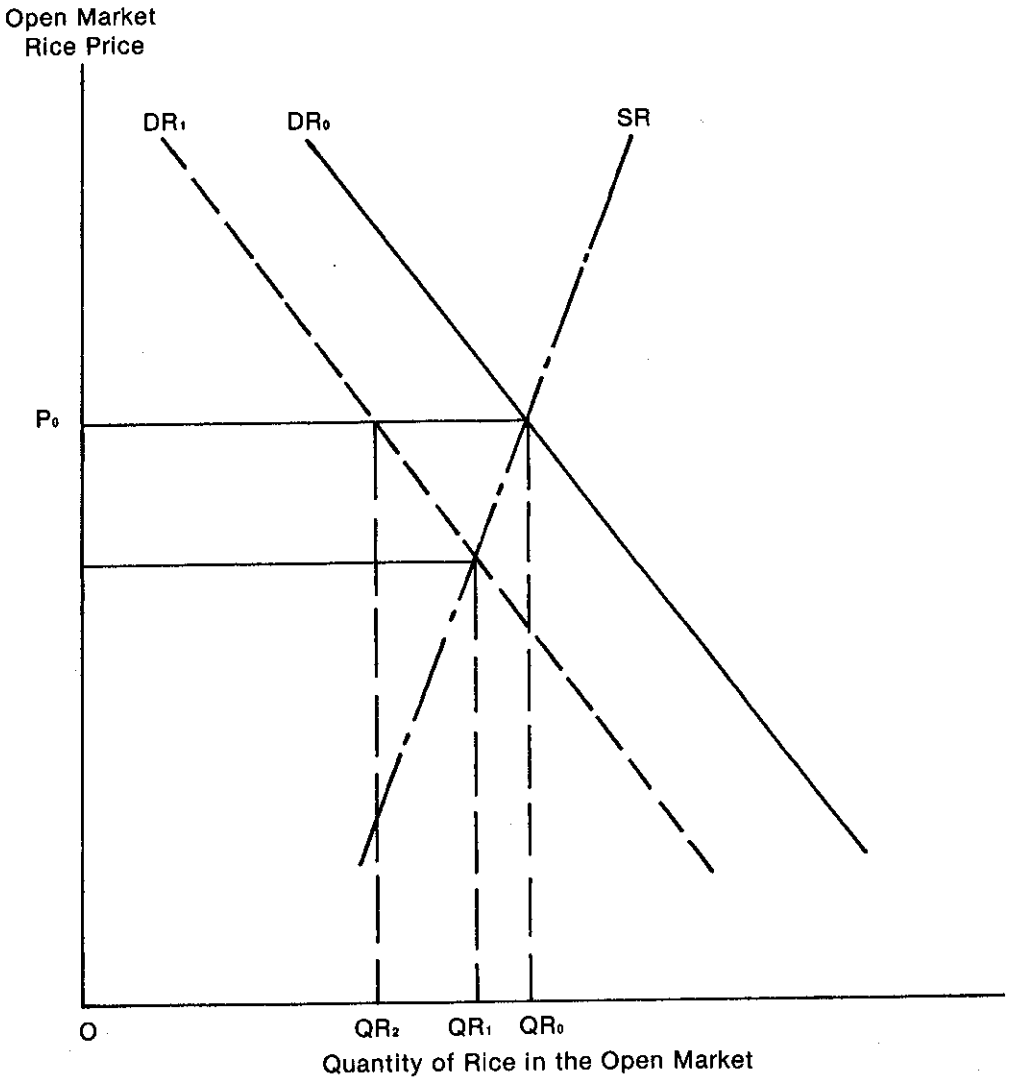
Within the framework, the price of rice in the open market is determined by the interaction of the market demand for and supply of local rice. The introduction of rationing can be thought of as affecting this market in two ways: (1) assuming local rice and imported ration rice are perfect substitutes, a given increase in ration rice will reduce the demand for local rice by the same amount (a shift to the left of the open market demand curve), and (2) the income of consumers receiving ration rice will go up by an amount equal to the savings in their foodgrain budget resulting from the difference between market and ration price for each unit of ration rice, if the rationing is effective.[21] This second effect will shift the demand curve to the right. In this paper, the first is referred to as the substitution effect, the second is referred to as the income effect, and the net effect is termed the market displacement effect of rationing. The market displacement effect will be smaller for wheat than for rice. Substituting wheat for rice in the ration would mean a smaller leftward shift of the demand curve for local rice because the two products are imperfect substitutes. The income effect of wheat distribution through rationing will be in the same direction as for rice, but the magnitude will be smaller because of the effect of imperfect substitutability.[22] The net result of the various opposing effects is expected to be such that the reduction in open market demand because

[21] L.J.J.B. Berlage. "Foodgrain Demand Supply Policies in Bangladesh" (Ph.D. dissertation, Massachusetts Institute of Technology, 1972).

[22] Mathematically the marginal rate of substitution of ration rice (r) for market rice (R) is defined as $\frac{dR}{dr} = -a_r$ and the marginal rate of substitution of ration wheat (w) for market rice (R) is defined as $\frac{dR}{dw} = -a_w$. In the context of Bangladesh, a_r is most likely to be less than or equal to one and a_w to be less than one.

Imperfect substitution may also exist between market rice and ration rice because of differences in processing. For example, ration rice in Bangladesh has been supplied mainly through imports of unparboiled rice, whereas the local market rice is usually parboiled. Generally, the marginal rate of substitution between the two is less than, but very close to, one; see L.J.J.B. Berlage, "Foodgrain Demand Supply Policies in Bangladesh."

Figure 1: Effect of rationing on the open market price for local rice



of an increase in the quantity of ration foodgrains would be smaller than the increase in ration. In other words, increased rationing will lead to a net increase in effective demand.

Specifically, Figure 1 shows the process of adjustment and price formation through the interaction of supply and demand on the market in a single year. In the figure, DR_0 represents the market demand curve for local rice at the initial position, DR_1 is the market demand curve after ration supply has increased, and SR is the market supply curve. The initial position is de-

fined by the amount of rice bought and sold QR_0 at price P_0.

Through imports, the government increases both rice and wheat distribution through rationing at the fixed prices. The extent of the shift in the market demand curve for local rice is determined as follows:

$$QR_0 - QR_2 = (a_r \Delta Q_r - \frac{\beta Y}{P} r) + (a_w \Delta Q_w - \frac{\beta Y}{P} w)$$

where

- P = market price of rice,
- ΔQ_r = increase in ration rice,
- ΔQ_w = increase in ration wheat,
- Y_r = increase in income due to ration rice,
- Y_w = increase in income due to ration wheat,[23]
- β = marginal propensity to consume rice,
- a_w = marginal rate of substitution of ration wheat for market rice, and
- a_r = marginal rate of substitution of ration rice for market rice.

A model of supply and demand incorporating rationing has been developed to show the interrelationships in the food distribution system. The model, which represents a compromise between what is desired and the limitations imposed by the existing data, is presented below:

$$QS = mQ^* - QP, \quad (1)$$
$$QD = B_0 + B_1P + B_2Y + B_3QR, \quad (2)$$
$$Y = \overset{*}{Y} + QR\,(\alpha P - PR), \quad (3)$$
$$QR = U_r + d(MP + QP), \quad (4)$$
$$QP = U_q + aQ^*, \quad (5)$$
$$MP = U_m + c(Q^* - DD), \quad (6)$$
$$D = QD + QR, \quad (7)$$
$$QS = QD. \quad (8)$$

where

- QS = Rice available for open market sale including that part of production consumed at home;
- m = Proportion of gross production available for consumption;
- Q^* = Domestic gross rice production;
- QP = Internal procurement;
- QD = Consumption from market and home;
- P = Real price of rice (retail, medium quality);
- Y = Disposable income adjusted for rationing;
- QR = Foodgrain ration distribution;
- B_0, B_1, B_2, B_3 = Parameters to be estimated;
- Y = Disposable income without ration;
- α = Marginal rate of substitution of ration foodgrains (rice and wheat) for local rice;
- PR = Weighted average foodgrain price at ration shops in real terms;
- MP = Import of foodgrains;
- U_r, U_q, U_m, d, a, c = Parameters to be estimated;
- DD = Consumption requirement used as a basis for import planning (15.5 ounces per capita per day); and
- D = Total consumption of foodgrains.

All variables except prices are in per capita terms, the value of m is assumed to be 0.9.

Equation (1) represents the net availability of foodgrains for marketing sale and is a price invariant supply function. The invariance of supply to market prices reflects the short run nature of the analysis as well as the dominance of weather factors in the supply of foodgrains from domestic sources. Equation (2) is a market demand function in which rationing has been included as a shift variable. Equation (3) provides a mechanism for adjusting income from rationing. Equations (4), (5), and (6) represent the main decision variables. Equations (7) and (8) are identities.

By substituting equations (1) and (2) for equation (8), the system of eight equations can be reduced to a system of six equations where D, QR, QP, MP, P, and Y are endogenous and Q^*, $\bar{Y}$ and PR are exogenous. Since arbitrary decisions as well as uncertain factors can influence QR, QP, and MP, these potential policy variables are not entirely endogenous. The intercept terms—U_r, U_q, and U_m—reflect the effect of arbitrary changes in decisions on these variables. These can be treated as policy variables subject to completely arbitrary decisions by setting the values of d, a, and c at zero and working only through the U_r, U_q, and U_m.

It should be noted that a negative QP is equivalent to an open market sale operation by the government; hence the consequence of such an operation can be evaluated. Simultaneously solving for the values of endogenous variables at given values of exogenous variables provides an opportunity to trace out policy implications.

Data

Although most data have already been discussed in earlier chapters, some additional variables, including quantity consumed, disposable income, and real prices, are elaborated here.

A direct measure of the quantity consumed from the free market and at home (QD) is not available. An indirect estimate is therefore made that assumes that QD equals gross domestic production minus the quantity for seed, feed, and wastage (which together account for 10 percent of gross production) and the quantity procured by the government.[24]

Per capita disposable income (Y) is based on estimates of GNP at current market prices minus direct taxes. GNP at current market prices is obtained by adding indirect taxes to GNP at factor cost.[25]

To transform them into real prices, nominal prices[26] were deflated by a non-rice food price index, which was avail-

[24] This measure of QD will differ from actual values by a quantity equal to changes in stock held by producers and traders. Failure to incorporate private stocks in the measurement of QD is likely to result in overestimation of consumption in good years and underestimation in bad years. Another omitted variable in the demand side, the effect of permanent income on current consumption, is expected to counteract the effect of omission of stock changes on the supply side. In a society such as Bangladesh, where poverty is widespread, even moderate food scarcity will cause the poor to attempt to support their consumption of staple foods by selling movable and immovable properties like livestock, utensils, land, and any other assets they possess. They attempt to replenish these in good years. This permanent income effect will work in the opposite direction of the effect of stock changes in both consumption and market prices.

[25] The main sources of GNP estimates are M. Alamgir and L.J.J.B. Berlage, "Foodgrain (Rice and Wheat) Demand, Inport and Price Policy for Bangladesh," *Bangladesh Economic Review* 1 (January 1973): 25-58 for the period up to 1968-69, and the estimates of the Bureau of Statistics and the Planning Commission for subsequent years.

[26] Prices of medium quality rice represent the general rice prices in this study. The general rice price should be a weighted average of coarse, medium, and fine quality rice. Time series price data for all these varieties are not available. The medium quality rice price would be higher than the weighted average rice price mainly because of the higher weights of coarse rice.

able for the years up to 1968-69,[27] and was updated with recent data.[28]

Estimation of Equations

Estimating equation (2) requires a prior estimate of the marginal rate of substitution (MRS) of ration foodgrains for market rice since the MRS is needed to calculate the adjusted disposable income (Y). Theoretically, the MRS should be equal to the price ratio when the utility derived from consuming one food is independent from that of consuming the others. In a rationing system with a restricted supply and arbitrary pricing, the MRS should be equal to or greater than the price ratio of market rice to ration foodgrains.[29] In most years the price ratios of ration foodgrains to market rice prices were above 0.4, so we take this as the lower bound. Through an iterative process, taking various values of the MRS increasing from 0.4, we estimate equation (2), $(QD + \alpha QR) = f(Y,P)$. This iterative process shows that the value of 0.70 for the MRS gives the best estimate, with coefficients that are highly significant as well as income and price elasticities that are considered reasonable in the context of Bangladesh.

Estimating equation (2) in an unrestricted form with the variable Y and a separate ration income variable Y_S (where $Y_S = QR\ [\alpha P - PR]$), did not give satisfactory results.[30] The coefficients were mostly insignificant and the variable Y_S did not bear a proper sign. Moreover, it is unlikely that the coefficient of QR will be larger than 1.0.[31] Estimating the equation under restriction yields,[32]

$$QD = 297.22 + 0.3359Y - 150.15P$$
(t values) (7.538) (3.147) (−2.664)
$$- 0.70QR;\ \bar{R}^2 = 0.69,\ DW = 2.008.$$

All coefficients are significant at above the 95 percent level of confidence. The Durban-Watson statistic indicates no serial correlation. Estimated income and price elasticities work out to be 0.37 and −0.23, respectively.

The coefficient of QR represents the weighted average of marginal rates of substitution of ration rice and wheat for local market rice. This coefficient would quite accurately explain changes in the market price of rice due to changes in the ration offtake only when the proportions of wheat and rice in the ration foodgrains are similar to the average (35 percent rice, 65 percent wheat) of 1961-76. Evaluating policies requires that the separate effects of ration rice and wheat be known. To obtain these, a range of plausible values for the MRS of ration rice and wheat for local rice from 0.75 to 0.95 for rice and from 0.50 to 0.75 for wheat was selected. The equation $QD + a_r QR_r + a_W QR_W = f(Y,P)$ was then estimated.

This process shows that values of 0.92 for a_r (MRS of ration rice) and of 0.58 for a_W (MRS of ration wheat for market rice) give the best estimate of the equation. The coefficients of income and price variables are highly significant and the elasticities are reasonable.

Estimating equation (4) led to the fol-

[27] L.J.J.B. Berlage, "Foodgrain Demand Supply Policies in Bangladesh."

[28] The products incorporated into the index and their weights are: gram (chick pea), 3.72; milk, 5.51; ghee (clarified butter), 0.86; mustard oil, 5.19; meat, 4.34; fish, 8.07; potato, 1.22; onion, 0.71; salt, 0.84; chile, 1.09; sugar, 2.31; gur (unrefined sugar), 0.65; tea, 2.28. The sum of the weights is 37.69.

[29] L.J.J.B. Berlage. "Foodgrain Demand Supply Policies in Bangladesh."

[30] The estimated equation is as follows:

$$QD = 342.33 + 0.1135\ Y - 1.9434\ Ys - 66.702P - 1.18QR$$
(t values) (4.980) (0.447) (0.823) (0.590) (−0.786)

[31] This contrary result may bedue partly to multicollinearity (the correlation coefficient between Ys and $\hat{Y}$ is −0.08; and between Ys and Qr, 0.76) and partly to improper adjustment for the income effect of ration foodgrains.

[32] Time-series data from 1960-76 were used in the estimation, but 1971-72 and 1974-75 were excluded because of abnormalities.

lowing results:

$$QR = 9.609 + 0.706(MP + QP);$$
$$(t \text{ values}) \quad (2.7845)\ (8.7865)$$
$$\bar{R}^2 = 0.86; \ DW = 1.95.$$

In estimating this equation for the quantity of foodgrain ration consumed, the difference between ration and market price was also included as an explanatory variable but did not yield a significant coefficient. It was observed that the coefficient was significant only when market and ration prices are close—as they were in some months of 1976-77. Even then, the t-value of the coefficient was only 1.065. Ration offtake appears to be largely determined by the availability of government stocks. However, only about 71 percent of the incremental acquisition of public grain in any year goes to rationing in the same year, reflecting the time lag in acquisition and distribution.

Annual data did not provide any satisfactory estimate of equation (5), for which details are presented in the section on domestic procurement. Based on interdistrict data for 1975-76 and 1976-77, equation (5) is as follows:

$$QP = 31.85 + 0.1255\dot{Q}^*; \ \bar{R}^2 = 0.59$$
$$(t \text{ values}) \quad (2.035) \quad (5.0635)$$

Using annual data, the estimate of equation (6) is:

$$MP = 33.173 - 0.6169\,(Q^* - DD);$$
$$(t \text{ values}) \quad (9.5588)\ (-4.4017)$$
$$\bar{R}^2 = 0.60; \ DW = 2.154.$$

The equation indicates that domestic shortfall is an important determinant of the quantity imported, explaining about 60 percent of the variation in imports.

Interrelationships Under Various Scenarios

Once the coefficients of the six equations have been estimated, the model may be solved. Solutions are presented here along with brief discussions and policy implications of these results, which are based on a number of production scenarios.

Three production scenarios are conceived for 1980; the first represents a bad crop year, the second a normal crop year, and the third a good crop year. Rice production is assumed to be 11.88 million tons, 13.50 million tons,[33] and 15.12 million tons, respectively. Output of 13.50 million tons represents a downward adjustment in the production target for the final year of the present two-year plan. The high and low figures represent the average variation of about 12 percent. The population is projected to be 89.92 million by 1980.

On the basis of the relationships postulated in the equation of the model, consumption, prices, imports, procurement, and ration offtake under the three scenarios are as shown in Table 9. These estimates assume that per capita income from agriculture changes at the same rate as rice production, and that nonagricultural income increases at the rate of 5.5 percent annually. Prices are expressed in nominal terms at the 1975-76 general level of prices.

If past relationships in the foodgrain sector persist in 1979-80, rice prices could range from Tk 232 to Tk 170, depending on which production scenarios are implemented. The rice price in scenario 3 is about 10 percent higher than the actual average of 1975-76. Tables 10 and 11 present the impact on consumption and prices of various levels of imports, procurement, rationing, and open market sales, all of which are treated as exogenous policy decisions. It is assumed that a security stock can do away with the time lag between stock acquisition and dis-

[33] A production of 13.5 million tons in 1980 implies an annual average growth rate of 2.25 percent between 1973-74 and 1979-80.

Table 9—Scenarios of foodgrain supply, demand, and prices, 1980

Item	Scenario 1	Scenario 2	Scenario 3
		(million tons)	
Total Production	11.88	13.50	15.12
Total Consumption	12.57	13.27	13.97
Per Capita Consumption[a]	313.20	330.60	348.00
Rice Price[b]	232.20	199.80	169.60
Imports	2.76	1.76	0.76
Ration Offtake	2.10	1.54	0.97
Internal Procurement	0.21	0.42	0.62
Pipeline Stock[c]	0.87	0.64	0.41

[a] Lbs.

[b] Tk per maund.

[c] Reflects the portion of import and domestic procurement not going to distribution in the same year.

Table 10—Per capita consumption and prices of rice with a policy of distributing all public grains through rationing

Import[a] and Procurement[b] Level	Scenario 1		Scenario 2		Scenario 3	
	Per Capita Consumption	Price	Per Capita Consumption	Price	Per Capita Consumption	Price
	(lb)	(Tk/maund)	(lb)	(Tk/maund)	(lb)	(Tk/maund)
M1P0	327.63	209.74	348.51	168.27	369.38	129.92
M1P1	327.63	216.05	348.51	174.45	369.38	135.90
M1P2	327.63	219.03	348.51	177.65	369.38	138.98
M1P3	327.63	225.61	348.51	183.92	369.38	145.30
M2P0	312.31	227.59	337.05	182.42	361.78	139.60
M2P1	312.31	233.92	337.05	188.66	361.78	145.77
M2P2	312.31	237.17	337.05	191.85	361.78	148.88
M2P3	312.31	227.34	337.05	198.45	361.78	155.29
M3P0	296.99	244.5	325.59	195.56	354.19	149.17
M3P1	296.99	250.47	325.59	202.08	354.19	155.26
M3P2	296.99	253.44	325.59	205.30	354.19	158.40
M3P3	296.99	260.32	325.59	211.92	354.19	164.87

[a] Import levels (M) in million tons:

	Scenario 1	Scenario 2	Scenario 3
M1	2.46	1.84	1.22
M2	1.85	1.38	0.91
M3	1.23	0.92	0.61

[b] Procurement (P) Levels:
P0 = no procurement
P1 = 2 percent of production
P2 = 3 percent of production
P3 = 5 percent of production

Table 11—Per capita consumption and prices of rice with a policy of distributing imported grains through rationing and open market sale

Import[a] and Open Market Sale[b] Levels	Scenario 1		Scenario 2		Scenario 3	
	Per Capita Consumption	Price	Per Capita Consumption	Price	Per Capita Consumption	Price
	(lb)	(Tk/maund)	(lb)	(Tk/maund)	(lb)	(Tk/maund)
M1H1	327.63	203.43	348.51	164.17	369.38	127.55
M1H2	327.63	197.27	348.51	160.16	369.38	125.24
M1H3	327.63	191.36	348.51	156.23	369.38	122.95
M2H1	312.31	222.82	337.05	179.29	361.78	137.92
M2H2	312.31	218.13	337.05	176.25	361.78	136.16
M2H3	312.31	213.56	337.05	173.22	361.78	134.41
M3H1	296.99	240.95	325.59	193.70	354.19	147.97
M3H2	296.99	237.79	325.59	191.62	354.19	146.77
M3H3	296.99	234.67	325.59	189.54	354.19	145.57

Note: Selection of the import levels is based partly on historical deviations and partly on personal judgment.

[a] Import levels (M) in million tons:

	Scenario 1	Scenario 2	Scenario 3
M1	2.46	1.84	1.22
M2	1.85	1.38	0.91
M3	1.23	0.92	0.61

[b] Levels of open market sale (H):
H1 = 10 percent of imports
H2 = 20 percent of imports
H3 = 30 percent of imports

Open market sale exceeding 30 percent of imports is extremely unlikely since it would severely restrict urban rationing.

tribution,[34] and that the open market sale of foodgrains introduced in 1977-78 will be effectively continued. The main conclusions are abstracted here.

While total availability of foodgrains has the most dominant influence in determining the market price and the upper limit of consumption, it is not the sole determinant. Market price can also be influenced by policies relating to ration distribution, open market sale, and internal procurement. At given levels of production, imports, and income the market price of rice can be raised or depressed by changing the proportions of public stock allocated to the open market and to rationing. However, the percentage of change in market price resulting from such policy decisions is not the same in all scenarios. The effect is larger in the bad crop year (low level of availability) than in the good crop year, mainly because of the difference in the income effects from rationing.

The desirable consumption level of foodgrains is set forth in government documents as an average of 15.5 ounces per capita per day (or 353.4 pounds per year) and the desirable price level for rice is considered to be around Tk. 145

[34] By 1977-78 government had already built up a stock of about 800 thousand tons. The objective is to maintain a security stock of about one million tons for the 1976-77 population level.

per maund.[35] These desirable levels of consumption and price are attainable in scenarios 3 and 2 with a normal level of imports only if policies pertaining to open market sale and the security stocks necessary for such sale are effective. But it would be extremely difficult to maintain these consumption and price targets in the bad crop scenario unless larger imports of foodgrains were possible.

In general, the primary policy challenge in a bad crop year is to prevent the market price from rising and the consumption level from falling, while in a good crop year, as in scenario 3, the main problem is to prevent prices from falling. However, maintaining adequate imports to support consumption in a bad crop year is extremely difficult. Likewise, cutting imports drastically during a good crop year is difficult to achieve because of rationing obligations. Given these limitations, allocating a larger share of public stock to open market sale[36] in a bad year would help hold down prices. The larger the shortfall in imports, the stronger the need to increase open market sales. In a good crop year, as in scenario 3, the reverse is the case. Pressure to increase ration distribution through a larger quota and expanded coverage has been intense in bad crop years, when the gap between market and ration prices widens. Effective open market sales would reduce this pressure by depressing market prices.

As the system is being run at present, internal procurement appears to be important mainly in scenario 2 (for partly supporting seasonal prices) and in scenario 3 (for supporting both average and seasonal prices). However, if open market sale is used as a continuing policy tool, and if foodgrain imports are able to meet all shortfalls in production on a static per capita basis, gross internal procurement could be quite heavy even in a bad crop year. For example, in scenario 1, if foodgrains are imported to reach a per capita consumption target of 15.5 ounces per day regardless of target price and the ability of the level of income to support such imports, and if a large portion of the imported foodgrains is channeled through the open market, imports will lower the market price more sharply than would an equivalent increase in domestic production. Countering such a fall in the market price would require substantial internal procurement, even in a bad crop year. Farmers with a surplus would unload their foodgrains to the government at the support prices while consumers would increasingly get supplies from government's open market sales. Although quite unlikely, this possibility requires that a target market price[37] become one of the bases of determining import requirements.

Finally, the effect of rationing and open market operations on the market rice price is larger when public stocks have more rice than wheat. Open market sales of wheat would have to be about 42 percent larger than such sales of rice in order to depress market price the same amount. This has implications for the composition of foodgrain imports. As long as the ratio of wheat prices to rice prices in the international market remains below the domestic rate of substitution of wheat

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[35] This price level is considered ideal for the jute-rice acreage balance, as explained in a later section of this paper. This level of rice price is also about at par with normal international prices of rice.

[36] Open market sale also has some operational problems arising from the low level of public stock and the uncertain behavior of private trade in response to such sales. These are discussed further in a later section of this paper.

[37] It could vary, reflecting a compromise of conflicting forces.

for rice at the margin, most of the imported foodgrains could be wheat. But this will restrict open market operation in the bad crop year. Open market sale of wheat in large quantities is not desirable. The free market for wheat is extremely small, and any open market sale of wheat from public stock is likely to disrupt the structure of the growing wheat market, possibly jeopardizing the government's present programs to develop this market and expand wheat production.

5

PUBLIC FOODGRAIN DISTRIBUTION AND POVERTY

The importance of public foodgrain distribution as a variable influencing the market for foodgrains has already been indicated in this paper. This chapter will focus on the more specific question of who benefits from public distribution. It will attempt to determine the income groups on which rationing has the most impact and to determine what redirection, if any, of public distribution efforts is necessary.

Income Distribution and Rationing Foodgrains

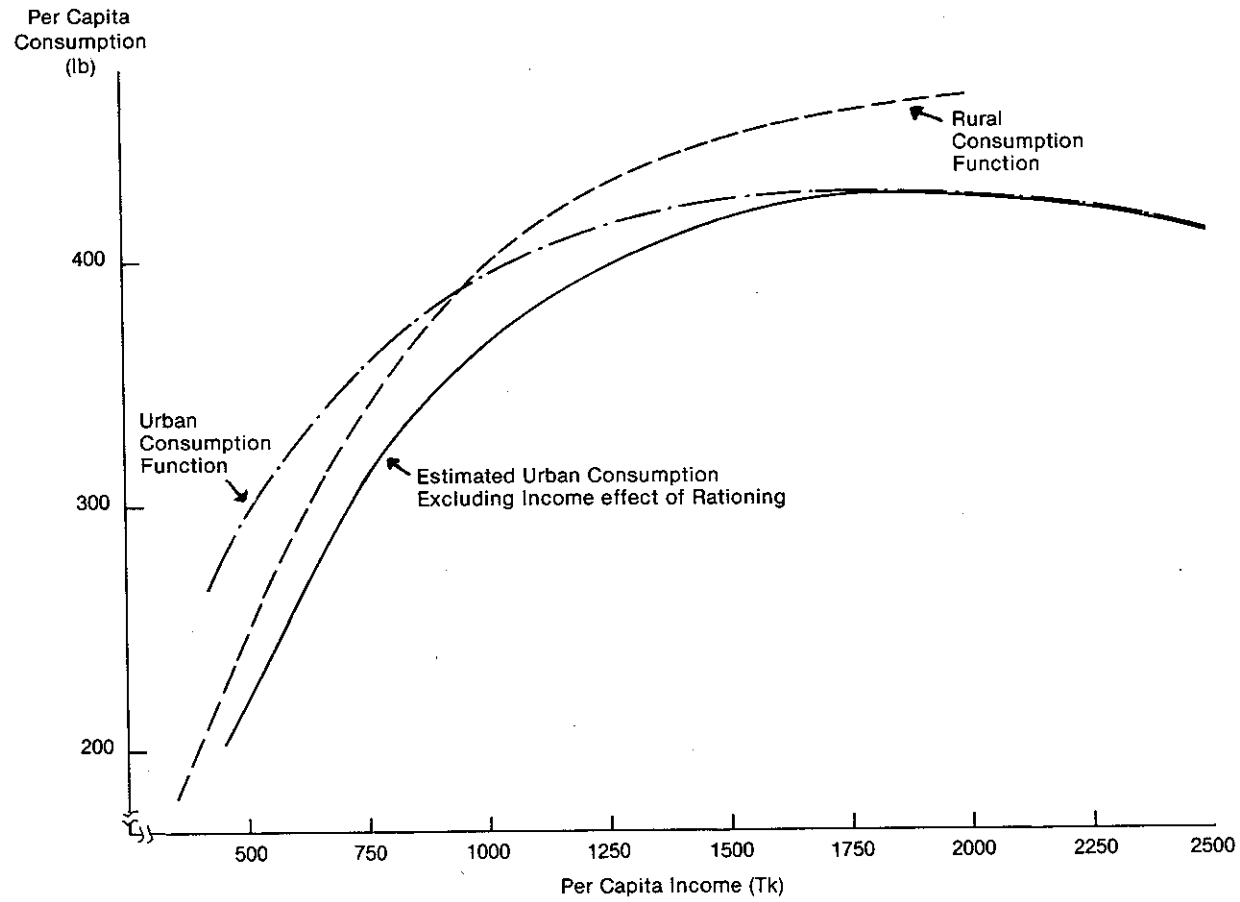
Because there are no data (based on sample surveys) on the quantities of ration foodgrains received by people in various income groups, estimates are calculated based on 1973-74 Household Consumption Survey data. The large difference between ration and market prices in this year should have provided consumers with a strong incentive to draw all ration foodgrains. Moreover, the large volume of ration supply should have minimized the chance of cardholders being refused rations. Rationing conditions in 1973-74 would therefore by very close to the assumptions made in these respects. For a detailed description of the methods used to estimate receipts of ration foodgrains by various income groups, see Appendix 1.

Table 12 presents the estimated distribution of ration foodgrains among low income urban groups.[38] Consumption figures of the 1973-74 survey indicate that foodgrain consumption in urban areas was higher than that of the corresponding income groups in rural areas.[39]. This may be because the per capita supply of ration foodgrains in urban areas is substantially higher than in rural areas. To substantiate this point, an estimate of per capita consumption of foodgrains, excluding the income effect of rationing, is made for the urban income classes. The resulting consumption function for foodgrains in urban areas is shown in Figure 2 and Table 12, column 8. The curve in Figure 2 comes close to the rural foodgrain consumption function in the lower income range and to the urban foodgrain consumption function (including the income effect of rationing) in the upper income range. This is approximately

[38] The definition of urban centers in the population census includes all municipal areas. There were 108 such urban areas in the 1974 census including some thana headquarters.

[39] For a given level of income, higher per capita consumption of foodgrains in rural areas than in urban areas would be expected for a number of reasons. First, urban people have to spend more of their income on housing, clothing, services, etc., than rural people. Second, foodgrain prices are generally higher in urban markets than in rural areas. Third, rural occupations are generally more energy exhausting the urban occupations, implying the need to spend a larger share of income on foodgrains. Of course, urban and rural living conditions in the low income categories are not very different in Bangladesh, where relatively developed business and commerce centers at the periphery of rural areas are counted as urban areas. Nevertheless, consumption of foodgrains by low income groups in urban areas would be expected to be less than, or at best equal to, that of the corresponding income groups in rural areas.

Figure 2: Estimated urban and rural consumption functions for foodgrains, 1973-74



Note: Based on the double log inverse function using 1973-74 household survey data.

Table 12—Estimated distribution of ration foodgrains among income groups, 1973-74

Income Group	Rural			Urban			
	Total Actual Consumption[a]	Ration Received	Ration as a Percent of Consumption	Total Actual Consumption	Ration Received	Ration as a Percent of Consumption	Estimated Consumption Excluding Income Effect of Ration[b]
	(lb/capita)		(percent)	(lb/capita)		(percent)	(lb/capita)
Less than 100	168.18	24.14	14	263.11	235.80	90	198.90
100-149	221.99	21.94	10	277.11	261.50	95	231.00
150-199	269.70	29.08	11	299.85	317.40	106	243.80
200-249	307.02	32.59	11	326.80	337.80	103	281.60
250-299	325.32	36.22	11	338.17	343.50	102	300.50
300-399	357.95	31.72	9	358.44	323.70	90	328.50
400-499	375.00	30.13	8	359.43	281.70	78	339.60
500-749	402.94	27.49	6	380.69	249.00	65	370.22
750-999	429.63	24.83	6	391.81	251.80	64	384.91
1,000-1,499	452.38	—	—	406.15	246.60	61	402.09
1,500-1,999	436.80	—	—	417.52	250.70	60	415.93
2,000 and above	456.58	—	—	401.95	239.90	60	401.11

[a] Computed from Bangladesh, Bureau of Statistics, *A Report on the Household Expenditure Survey of Bangladesh 1973-74* (Dacca, 1978).

[b] The income effect of rationing is calculated for each income class based on formulas presented in Appendix 3.

what would be hypothesized to be the true urban consumption function of foodgrains in the absence of the rationing system. Assuming that this contention is true, one could also conclude that the estimates of ration distribution by various income classes presented in Table 12 are quite close to reality.

The estimates of ration foodgrains received show that low income urban consumers obtain 90 to 100 percent of the foodgrains they consume from ration sources, while rationing provides only 9 to 14 percent of the foodgrains consumed by rural low income groups.

Because of the mechanisms of the categories of rationing oriented toward such groups as government employees and industrial workers, the ration received by households with incomes ranging from Tk 150-300 per month appears to be higher than their consumption. This has supported the income of low-paid government employees and workers in the urban areas, since these groups of urban consumers frequently supplement their low incomes by reselling ration foodgrains in the open market. Such sales were witnessed in the Dacca market by the members of the IFPRI/World Bank Food Policy Review Mission in March 1977.

The estimates of ration distribution for 1973-74 show that 9.2 percent of the population, which is urban, received about 55 percent of the total ration foodgrains and the remaining 90.8 percent of the population, which is rural, received only 45 percent of the ration. Excluding the rural-based special categories, such as government employees, school teachers, the military and police services, and industrial workers (those who are urban-

like in their occupations, incomes, and consumption patterns, but are living in rural areas) the share going to native rural consumers in 1973-74 was only about 34 percent. And while some rural farmers do not depend on the open market for their foodgrains, rural landless laborers, small farmers, and people in nonfarm occupations (fishermen, petty sales workers, etc.) are considered largely dependent on the open market. According to the Land Occupancy Survey (LOS) of 1977, 32 percent of rural households were landless: they did not own any cultivated land in the survey year.[40] These landless households comprise about 26 percent of the rural population. The 1973-74 Household Survey shows that about 26 percent of the rural population lived in households with incomes of less than Tk 300 per month. Most of these people would fall in the category of landless rural poor identified in the LOS of 1977 and also in a 1973-74 study by Abdullah et al.[41] Their absolute number is estimated to be about 2.6 times the total urban population; yet only about 34 percent of the foodgrain ration was allocated to the native rural consumers, while about 66 percent went to urban and urban-like consumers in 1973-74.

The distribution of ration foodgrains between urban and rural consumers is not likely to be substantially different in other years. Public foodgrains under modified rationing are the main vehicle serving the rural population. Distribution under this category in 1974-75 (the famine year in Bangladesh) was about 26 percent lower than in the previous year. Ration distribution under the modified rationing category was 5 to 15 percent higher during 1969-70 to 1972-73 than it was in 1973-74. A crucial election[42] in 1970 might have influenced the ruling political organization to allocate more foodgrains to rural people through modified rationing between 1969-71. But the higher proportions of foodgrains under the modified rationing category in 1971-72 and 1972-73 does not mean that the share of rural consumers went up accordingly. Because of the Civil War in 1971-72, the physical and organizational infrastructures during 1971-72 and 1972-73, particularly in the rural areas, were such that an increased flow of foodgrains from government stocks to rural areas could not occur.

Some Policy Implications

The fact that rural poverty has increased, as was noted in Chapter 3, and that public foodgrain rationing has extremely limited coverage indicate the seriousness of the problem for the rural poor in Bangladesh. Some alleviation of this problem may be provided through two foodgrain distribution options: a rural rationing scheme and open market sale operations.

An Extended Rural Rationing Scheme

In order to determine the effect of a rural rationing scheme, a disaggregated analysis tracing the implications of rural rationing for the poorest 26 percent of the rural population was conducted. The poorest 26 percent was selected because it comprises that segment of the rural population termed "extremely poor" in Chapter 3. Moreover, any rationing scheme for a specific target group must have a clear-cut criterion for inclusion of consumers in the scheme. Because it has already been shown that about 26 percent of the rural population was land-

[40] F. Thomasson Jannuzi and James T. Peach, *Report on the Hierarchy of Interests in Land in Bangladesh* (Washington, D.C.: U.S. Agency for International Development, September 1977).

[41] A. Abdullah, Richard Nations, and Musharrof Hussain, SIDA/ILO *Report on Integrated Rural Development Program* (Dacca: International Rural Development Program, 1974).

[42] The 1970 election provided the platform for demanding regional autonomy for what was then East Pakistan.

less wage earners, a land ownership criterion can be employed to include this segment of the rural population in the rationing scheme.

Based on 1973-74 Household Consumption Survey data, the poorest 26 percent of the rural population includes the five low income classes shown in Table 12. The core of the analytical approach rests on behavioral assumptions about how households in various income groups will change their expenditure allocations for foodgrains in response to the rationing scheme. A detailed note on methodology is presented in Appendix 3. A ration quota of six ounces per capita per day, equivalent to the present urban ration quota, was selected for analysis. Two alternative levels of ration prices and compositions of ration foodgrains are considered. The two prices are:

1) P_1, the low ration price prevailing in 1973-74 (Tk 0.55 per pound of rice and Tk 0.37 per pound of wheat); and
2) P_2, a hypothetical ration price that would just allow the lowest income group (with per capita income as in 1973-74 Household Survey) to accommodate all ration foodgrains within the foodgrain budget (Tk 0.78 per pound of rice and Tk 0.49 per pound of wheat).[43]

The selection of the ration composition is based on the following considerations. First, a drastic change in consumption patterns is assumed to be difficult in the short run. Therefore, the selected composition is kept close to present patterns of consumption. Second, rural rationing will reduce market demand, requiring more domestic procurement to prevent market prices from falling. This procured grain will be rice primarily, which will have to be recycled through the rationing scheme. Of the two alternative ration compositions, the first, C_1, consists of 60 percent rice and 40 percent wheat. The second, C_2, is 40 percent rice and 60 percent wheat.

Thus, there are four combinations of ration prices and ration compositions: C_1P_1, C_1P_2, C_2P_1, C_2P_2. The effects of each of these combinations are presented in Tables 13 and 14.

The rationing scheme for the rural poor would increase the average consumption of the five lowest income groups by 6.8 to 14.6 percent. A combination of a low ration price and a higher proportion of wheat in the ration causes the largest increase in consumption. The consumption of the lowest income groups (less than Tk 100 per month) would increase by 25 to 43 percent, while that of the top income group considered (Tk 250-299 per month) would increase by about 6 to 12 percent.

Introduction or extension of foodgrain rationing would increase demand for nonfoodgrain commodities. In this study, this increase ranges from about 8 to 19 percent of the foodgrain budget and appears to be larger than the percent increase in consumption of foodgrains. A large part of this increased demand for nonfoodgrain goods is likely to be for other foods.[44] This has important impli-

[43] The hypothetical ration price is considerably lower than 1975-76 ration price levels (i.e., Tk 1.1 per pound of rice and Tk 0.85 per pound of wheat). In the absence of a rising per capita income of the rural poor between 1973-74 and 1975-76, selection of 1975-76 ration prices would have severely restricted the access of the rural poor in the proposed rural rationing scheme. Thus, an extremely low level of income poses serious constraints in increasing consumption among rural poor, even with a subsidized foodgrain rationing scheme, unless a substantial subsidy can be afforded.

[44] The low income group spends 51 percent of its budget on foodgrains and 26 percent on other foods; the average income group spends 43 percent of its budget on foodgrains and 31 percent on other foods; and the high income group spends 30 percent of its budget on foodgrains and 30 percent on other foods.

Table 13—Implications of an expanded rationing scheme for the rural poor by commodities, 1973-74

Item	Alternative Ration Composition and Prices			
	C_1P_1[a]	C_1P_2[b]	C_2P_1[c]	C_2P_2[d]
Initial consumption (1,000 tons)	2301.8	2301.8	2301.8	2301.8
Percent from wheat	31.0	31.0	31.0	31.0
Consumption with rationing (1,000 tons)	2542.5	2458.6	2636.6	2559.9
Percent from wheat	28.2	29.2	33.2	34.2
Percent increase in consumption	10.5	6.8	14.6	11.2
Ration quantity	1459.1	1459.1	1459.1	1459.1
Import quantity	830.6	746.7	924.74	847.94
Rice (1,000 tons)	247.0	163.1	183.0	106.2
Wheat (1,000 tons)	583.6	583.6	741.74	741.7 4
Domestic procurement (Reduction in market demand)	628.5	712.4	534.4	611.1
Rice (1,000 tons)	628.5	712.4	400.7	477.4
Wheat (1,000 tons)	0	0	133.7	133.7
Subsidy cost (billion Tk)	4.19	3.58	3.92	3.38
Increase in nonfoodgrain demand (percent of foodgrain budget)	19.1	11.7	14.0	7.6

[a] 60 percent rice at Tk 0.55/lb; 40 percent wheat at Tk 0.37/lb.
[b] 60 percent rice at Tk 0.78/lb; 40 percent wheat at Tk 0.49/lb.
[c] 40 percent rice at Tk 0.55/lb; 60 percent wheat at Tk 0.37/lb.
[d] 40 percent rice at Tk 0.78/lb; 60 percent wheat at Tk 0.49/lb.

cations for the energy intake of the ration recipient, because if there are no supply constraints in nongrain foods and no difference in calorie content between one dollar's worth of foodgrain and one dollar's worth of nongrain foods, rationing could increase calorie intake at a faster rate than it increases foodgrain consumption. Supply constraints in nongrain foods may push up prices of such foods, eliminating any additional impact of rationing on calorie intake. Therefore, the impact of foodgrain rationing on calorie intake will be larger where nongrain foods are relatively cheap in terms of calories per dollar and where there are few supply constraints on the increased availability of such foods.[45]

A high ration price and a ration with a larger proportion of wheat would cause the smallest increase in demand for nonfoodgrain goods.

The subsidy cost for a rural rationing scheme covering the poorest 26 percent of the rural population ranges from Tk 3.38 to 4.19 billion, depending on the ra-

[45] Public foodgrain distribution in Kerala, India, and Sri Lanka case studies conducted at the International Food Policy Research Institute support this point. See P. S. George, *Public Distribution of Foodgrains in Kerala—Income Distribution Implications and Effectiveness*, Research Report No. 7 (Washington, D.C.: International Food Policy Research Institute, 1979).

Table 14—Implications of an expanded rationing scheme for the rural poor by income, 1973-74

Income Group	Alternative Ration Consumption and Prices			
	C_1P_1[a]	C_1P_2[b]	C_2P_1[c]	C_2P_2[d]
	Increase in Consumption of Grain			
	(percent)			
Less than Tk 100	37.3	25.1	43.0	32.0
Tk 100-149	14.1	8.7	21.9	17.3
Tk 150-199	11.3	7.3	15.5	11.8
Tk 200-249	9.4	6.1	12.8	9.8
Tk 250-299	8.7	5.8	12.2	9.6
	Increase in Nonfoodgrain Demand as a Percentage of Foodgrain Budget[e]			
	(percent)			
Less than Tk 100	11.4	0	9.9	0
Tk 100-149	23.2	13.7	14.5	5.9
Tk 150-199	20.6	12.4	14.8	7.9
Tk 200-249	18.4	11.5	13.8	7.8
Tk 250-299	18.2	11.5	13.7	7.9

[a] 60 percent rice at Tk 0.55/lb; 40 percent wheat at Tk 0.37/lb.
[b] 60 percent rice at Tk 0.78/lb; 40 percent wheat at Tk 0.49/lb.
[c] 40 percent rice at Tk 0.55/lb; 60 percent wheat at Tk 0.37/lb.
[d] 40 percent rice at Tk 0.78/lb; 60 percent wheat at Tk 0.49/lb.
[e] These figures represent a percentage of the foodgrain budget in order to make them comparable with the figures in the first part of the table. Expressed as a percentage of the nonfoodgrain budget, the increase of nonfoodgrain demand would be about two times larger than the figures presented in this part of the table.

tion prices and ration composition. Excluding the top two income classes reduces the subsidy cost by 61.8 percent. Such exclusion will be operationally difficult, and even if it is possible, the subsidy cost still appears to be beyond the present budgetary means of Bangladesh. However, such a scheme might be possible if external aid, motivated by a global concern for meeting basic needs, were available on a massive scale. Even then, problems would still exist because rural rationing based largely on foreign food aid would depress domestic foodgrain prices unless there were simultaneous efforts to increase incomes of the poor.

If the reduction in market demand for rice and wheat resulting from expanded rationing is not offset by procurement, the market price of rice would fall 15 to 27 percent, depending on which combination of ration prices and composition (C_1P_1 . . . C_2P_2) were in operation, and assuming a supply elasticity of zero and de-

mand elasticity of −0.25. If the supply elasticity were 0.15,[46] the reduction in rice prices would range from 9.5 to 17.0 percent. Wheat prices would fall drastically, and the wheat market might collapse if alternatives C_2P_1 or C_2P_2 were in operation. Such price reductions could be prevented, however, if it were possible to raise income levels of consumers, particularly for low income groups. This again underscores the importance of policies for raising income of the rural poor as a solution to this problem of low level consumption.

Open Market Sales

In carrying out open market operations, the government can expand supplies and lower prices. Price elasticities of demand for various income groups have already been used to show the impact of high prices of foodgrains on consumption during the lean period. On the basis of price elasticities of demand for foodgrains at various incomes, it is possible to calculate the effect on consumption of the poorer groups resulting from a certain open market operation. In this exercise it is assumed that the objective of the operation is to increase the consumption of the lowest income rural group by about 17 percent,[47] which will cause prices to fall by 25 percent. Table 15 presents the increases in consumption by different income groups for this 25 percent drop in prices.

Table 15 indicates that low income groups increase their consumption of foodgrains more than the higher income groups as a result of reduced foodgrain prices. But unlike targeted programs, prices have effects that cannot be limited to selected groups. As a result, large quantities of foodgrains generally must be pumped into the market to cause the desired fall in prices. Assuming a price elasticity of market supply of zero, the increase in consumption presented in Table 15 will require total additional quantities of 0.667 million tons on the basis of the 1973-74 population. This additional quantity represents an increase of 5.32 percent from the initial level. A positive supply elasticity further increases the size of open market operations required to achieve the target. If we assume a supply elasticity of 0.2, the increase in the size of the open market operation will have to be 10.32 percent of the initial level of consumption: 1.29 million tons instead of 0.667 million tons.

These quantities represent net additions to aggregate supply of foodgrains. By using rationing, consumption of the lowest income group can be increased 25 to 43 percent with a net addition of only about 200,000 to 300,000 tons to aggregate foodgrain supply. Achieving the same increase in consumption through open market operations would require a fall in market price that might be totally impracticable.[48] Thus, open market sale would require a larger import volume or stock depletion than would rationing with a stable price.[49]

However, open market operations have

[46] John T. Cummings, "The Supply Responsiveness of Bangalee Rice and Cash Crop Cultivators," *Bangladesh Development Studies* 2, (April 1974): 235-251.

[47] This is about half of the average increase in consumption of this particular group in the case of rural rationing (Table 14). A larger increase is not assumed to be feasible through the market mechanism without severe problems.

[48] The estimated price elasticities will not be applicable for such a large fall in prices. A fall in prices of more than 40 percent may shift consumers from urban rationing to open market purchases, requiring an ever-increasing supply to cause the prices to fall.

[49] The amount required for open market operations is sensitive to market supply elasticity. While some information on production response to the price of foodgrains is available in the country, knowledge of market supply response in any market period is virtually nonexistent. If the open market operation changes the behavior of private traders, the supply elasticity in any market period could be quite large. When the stock levels with the government are low, the traders might anticipate the limited capacity of the government to influence the market, and therefore may withhold their stock, resulting in a sharper rise in prices.

Table 15—Changes in per capita consumption resulting from an open market price reduction of 25 percent

Income Group	Per Capita Consumption[a] 1973-74	New Consumption Level	Increase
(Tk/month)	(ounces/capita/day)	(ounces/capita/day)	(percent)
Less than 100	7.52	8.80	17.0
100-149	9.72	10.98	13.0
150-199	11.81	13.11	11.0
200-249	13.45	14.66	9.0
250-299	14.21	15.35	8.0
300-399	15.59	16.64	6.75
400-499	16.30	17.50	5.5
500-749	17.50	18.24	4.25
750-999	18.60	19.20	3.25
1,000-1,499	19.48	19.97	2.50
1,500-1,999	20.48	20.74	1.25
2,000 and above	19.54	19.54	0.0
All Groups	16.15	17.01	5.32

[a] Computed from Bangladesh Bureau of Statistics, *A Report on the Household Expenditure Survey of Bangladesh 1973-74* (Dacca, 1978).

a number of desirable aspects. They can be put into effect selectively in any particular season of the year without maintaining the additional permanent organizational structure necessary in the case of a regular rural rationing system. In addition, since the price elasticities of low income groups are higher than those for high income groups, they benefit the poor more than the rich and involve the least subsidy cost, although some subsidy will be unavoidable.[50] Finally, because of the rationing system in urban areas, urban demand for foodgrains is relatively insensitive to price changes (highly inelastic), providing a chance for rural consumers to gain proportionately more from open market operations than urban consumers.

The main disadvantage is that open market operations discourage producer incentive. A large quantity of foodgrain is required to cause a given fall in price, but in the absence of some reliable estimate of market supply elasticity, the quan-

[50] If the price of imported grains is higher than the domestic price (which has not been the case historically except in 1974-75—see Appendix 2, Table 21), the subsidy cost of open market sale could be high. Strictly speaking, a simple comparison of subsidy cost between the open market sale and the rationing programs are not valid because the programs have dissimilar impacts on consumption among various income groups. However, a comparison of subsidy costs between such programs can be seen in James Gavan, "The Calorie Gap in Bangladesh and Strategies for Reducing It," paper presented at the Nutrition-Oriented Food Policies and Programs Conference, Bellagio, Italy, 1977.

tity required for the operation is indeterminate, making advance planning difficult.

Considering the advantages and disadvantages, it seems that open market operations could be employed selectively during the year, particularly in a year when lean period prices tend to shoot above the normal peaks. In lean periods, selling foodgrains from public stocks on the open market for one or two months to lower prices 25 percent would require only a fraction of the amount. However, such an operation would have to be experimental in the beginning to observe how normal market supply behaves in response to government open market sale operations. For more discussion on this, see Chapter 6.

Conclusions

The analysis presented in this chapter indicates that about two thirds of the public distribution of foodgrains goes to urban and urban-like consumers, although only about 9.2 percent of the country's population is urban and the absolute number in the extremely poor category of rural population is about three times the total urban population.[51] The poorest 7 percent of the people in the country live in rural areas.

The ration system has been successful, however, in supporting the consumption of the urban poor. Without rationing, the consumption level of the urban poor, the poorest 15 percent of the urban population, might have been 15 to 24 percent below their actual foodgrain consumption level in 1973-74.

The rural poor's extremely low income seriously constrains improvement of consumption levels and nutritional status. Intervention policies such as extended rural rationing and open market sales for the rural poor involve either a large subsidy cost or low domestic prices for foodgrains. A low domestic foodgrain price is not considered conducive to growth in domestic foodgrain production. To improve the consumption level of the rural poor while acknowledging the difficulty of raising their income in the short run, a low domestic price for foodgrains along with a compensating policy of input subsidy to provide producers incentive could be a logical policy option in Bangladesh.[52] Input subsidy does not provide much of a direct benefit to the rural poor, however. A comparative analysis of input subsidy and price support is presented in the last part of this study.

Because an increased wheat supply has a smaller effect on domestic rice prices than an increased rice supply, and because wheat offers a proportionately higher gain in calories than rice for every dollar's worth of imports, it seems appropriate to encourage consumption of more wheat than rice among the rural poor. To do so may necessitate lowering wheat prices, which will severely restrict wheat production. This policy option calls for a complete reappraisal of the government's policy to increase wheat production, particularly a reappraisal of the opportunity cost associated with increased domestic production of wheat.

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[51] A comparison of urban population with the total depending on the open market for their foodgrains would have been appropriate, but data limitations constrained such a comparison. Nevertheless, rural nonfarm and landless households (including very small farms)—known to be dependent on markets—would together comprise a population about two to three times the urban population.

[52] Such a policy is necessary to prevent concentration of land in hands of large farmers because past experience indicates that small and marginal farmers sell their land to survive when prices are high. However, a broader analytical framework than the one adopted in the present study would have been useful in substantiating the conclusion.

Increasing the supply of ration foodgrains and/or lowering ration prices generates additional demand for other commodities, including nongrain foods, faster than it increases foodgrain consumption. Policies that increase the supply of cheaper nongrain foods, along with the public distribution of ration foodgrains, may improve the overall nutritional status of the rural poor. Studies on supply functions of nongrain foods therefore deserve special attention.

The average level of calorie intake of the rural poor is low, but becomes even worse in a year with a large shortfall in production and in the lean period of every year. Open market sale of foodgrains in rural markets under these situations may be quite effective in improving the nutritional status of the rural poor while minimizing the adverse impact on producer incentives. Without any knowledge of how private traders would react to open market operations, however, such policies warrant caution and experimentation in the initial stage.

Although it is generally thought that the income of the rural poor cannot be improved in the short run, some specific activities such as rural work programs and food for works programs can provide some immediate income support to the rural poor. Comprehensive analysis and intensive study is required before such programs are expanded to a size commensurate with the need for improvement of the nutritional level of the rural poor. Among the questions that must be answered in future study are:

1. What is the compatibility between the seasonal and regional nature of un- and underemployment and the seasonal and regional scope for such programs?
2. Do these programs create a net addition to employment and income for unemployment wage earners or reduce underemployment of farmers?
3. What are the implications of these programs for wage rates and prices and what is their indirect effect on the long run employment and income of the rural poor?
4. How productive are such programs? Do they involve a simple transfer of income or productive investment?
5. What are the budgetary and organizational implications of an expanded program commensurate with a certain degree of improvement in the nutritional status of the poor?
6. Is the system of paying wages in foodgrains necessarily better than paying wages in cash? What are the implications of the two systems for the composition of foodgrains, rural milling facilities, leakage, and storage?

Unless answers to these questions are obtained, the arguments for further expansion of works programs in rural areas will remain weak.

6

DOMESTIC PROCUREMENT OF FOODGRAINS AND SEASONALITY OF PRICES

Domestic procurement—voluntary or compulsory sale of foodgrains by producers and market intermediaries to the government—is an important element of food policy in Bangladesh. Procurement has been used to obtain grains for the rationing system, provide a support price to producers, and prevent smuggling across Bangladesh's border. This chapter examines how procurement has been used in the past and how it could be used in the future. The government employs two methods of procurement: a voluntary method in which government buys at a fixed price from producers and market intermediaries and a compulsory method that requires delivery of a predetermined quantity at a fixed price by producers and occasionally by market intermediaries. The compulsory method has frequently been limited to zones within five miles of the border.

Relationships Among Procurement, Prices, and Production

The quantity procured in any year is dependent on the government's efforts in procurement, the level of production, and the procurement price in comparison with the market price. Domestic procurement of rice exceeded 1.5 percent of gross production only in 1975-76, when 3.34 percent of rice production (about 5.9 percent of *aman* rice) was procured. Even under the compulsory system, substantial quantities of rice could not be procured. The wide variations in compulsory procurement reflect not only variations in production and in procurement prices relative to market prices, but also the extent of the government's determination to carry out the unpalatable program. The relevant time series data are presented in Table 16.

With the exception of 1975-76, the procurement price has been below the market (wholesale) price of rice. However, farm level prices are generally about 83 percent of the wholesale prices, so that the procurement price would appear to equal or exceed the producer's price in five out of 16 years. Even then, the quantity procured under the voluntary option in some of these years was quite small.

To determine the influences of procurement price and gross production on the quantity procured, a number of regression models were estimated. The first model used time-series data for 1959-76 to relate total and voluntary procurement to market price relative to procurement price and gross production. The results were not satisfactory, particularly when the procurement and production variables were included on a per capita basis. Given the wide variations in procurement efforts and in the methods adopted in various years, such results are not unexpected. Therefore, the most recent years of 1975-76 and 1976-77 were selected, when procurement of foodgrains was substantially higher and only the voluntary method was in operation. Data on production and procurement of *aman* paddy by district and on the harvest season price

Table 16—Procurement of rice and its relationship to production and price

Year	Gross Production	Procurement		Procurement Price	Market Price[a]	Procurement Price[b]/Market Price Ratio
		Total	Voluntary			
		(1,000 tons)		(Tk/maund)		
1959-60	8,480	24.2	11.6	19.69	24.10	0.82
1960-61	9,520	26.3	12.2	19.69	25.21	0.78
1961-62	9,470	10.1	2.1	19.69	24.76	0.80
1962-63	8,730	4.1	0.1	19.69	27.10	0.73
1963-64	10,460	124.8	95.3	21.71	25.09	0.87
1964-65	10,340	12.4	3.4	20.93	26.25	0.80
1965-66	10,330	93.0	0	21.71	29.14	0.75
1966-67	9,420	8.0	0	26.63	38.75	0.69
1967-68	10,990	22.0	12.0	28.21	34.30	0.82
1968-69	11,160	9.0	2.6	29.79	38.14	0.78
1969-70	11,820	9.0	2.1	29.79	37.87	0.79
1970-71	10,970	6.0	2.0	29.79	37.03	0.80
1971-72[b]	—	—	—	—	—	—
1972-73	9,930	51.9	0	54.00	69.05	0.78
1973-74	11,720	70.8	48.5	72.63	86.30	0.84
1974-75	11,110	138.0	0	120.00	205.49	0.58
1975-76	12,650	420.0	420.0	120.00	116.53	1.03

Source: Procurement price up to 1974-75: Bangladesh, Ministry of Agriculture, *Bangladesh Agriculture in Statistics* (Dacca, 1974). Data for 1975-76 acquired from unpublished documents provided by the Bangladesh Ministry of Food.

[a] Represents average wholesale price of rice during December-January, the procurement season.

[b] Because of the controversial nature of the data during this war year, none have been included.

of *aman* rice were available for estimating a regression model relating per capita procurement (QP) to per capita production (Q*) and procurement price relative to harvest season market price (PD). The estimated equation is as follows:[53]

$$QP = -5.6538 + 0.1255\,Q^{*}$$
$$(t\text{ values})\quad (-1.286)\quad (5.063)$$
$$-\ 1.2839\,PD;\ \bar{R}^{2} = 0.62$$
$$(-0.058)$$

The results show that interdistrict differences in production are the most significant factors (statistically significant at the 99 percent level of confidence) in explaining the interdistrict differences in procurement. Because of the limited range of the variable PD and multicollinearity, the results do not show the effect of price to be statistically significant.[54] Even the sign of the price coefficient is not what one would generally expect.

[53] The measurement of variables in per capita terms relates to total rural population, although agricultural population would be the relevant deflator. However, the proportion of agricultural population in the total rural population is not likely to vary enough from year to year to cause a significant difference in the resulting coefficients.

[54] The correlation coefficient between Q* and PD is 0.4. Regressing per capita procurement only against PD makes it statistically significant only at a 45 percent level of confidence and with proper sign of the coefficient.

Procurement price relative to market price may have some influence on the quantity procured, but its significance is masked partly because of multicollinearity and partly because of data limitation. The estimate of the elasticity of the quantity procured with respect to production is 1.86. About 64 percent of the variation in procurement among districts is explained by variations in per capita production.

The relationship between procurement, production, and procurement price relative to market price can be interpreted as a proxy for the relationship between marketed surplus, production, and prices discussed in an earlier section. This proxy would also indicate that marketed quantity is strongly influenced by the level of production while the influence of price is generally small.

Seasonality and Procurement

One objective of procurement is to prevent an unusually low price during the harvest season from affecting producer incentives. To operate procurement policies effectively and to determine the size of the procurement program, it is essential to know which factors cause seasonal dips in prices during harvest seasons. Of the three rice crops in Bangladesh, rice prices generally record their lowest levels during *aman*. A price support to this major rice crop indirectly provides some support to prices of the other two crops. Harvest season prices of *boro* and *aus* paddy[55] sometimes fall as low as or even lower than the harvest season *aman* paddy prices. Although this appears to contradict the earlier statement that prices are lowest in the *aman* harvest season, the contradiction is not real for two reasons. First, moisture content of paddy at harvest time is higher in *boro* and *aus* than in *aman*. *Boro* and *aus* crops are harvested during the rainy season, before plant growth has completely ceased, while the *aman* crop is harvested during the winter with dead and dry straw. Second, the quality of *aman* rice in terms of its medium grain size and minimal amount of broken grains is superior to the coarse *aus* rice and most varieties of *boro* rice. This quality factor makes a difference of 6 to 8 percent between the prices of *aman* and other rice crops.

In other words, the low price of *aus* and *boro* paddy is not a reflection of a seasonal glut in supply relative to demand as is the case for *aman* paddy. The seasonal pattern of rice prices may change in the future if the present trend toward *boro* production continues. Already some districts have emerged as major *boro* growing areas (e.g., Chittagong, Sylhet, Kishoreganj) where seasonal prices differ from the national average pattern and where price support for *boro* paddy would be as important as it would be for *aman* paddy.

In the past, program procurement has been limited mostly to rice harvested during *aman*. This season is expected to remain an important procurement season in the future. Therefore, this study attempted to estimate the relationship between the fall of rice prices during *aman* and the relevant explanatory factors.

There are a number of explanatory factors that could cause rice prices to fall during *aman*, including total rice production, distribution of ration foodgrains from government stocks, consumer income, producer liquidity situation, and speculative behavior of private traders. If total production is high because of a good *aus* or *boro* crop, traders tend to buy more than normal quantities for resale during the peak price season that occurs immediately before *aman*, an action that tends to have some spillover effect on *aman* prices.

[55] Paddy refers to unhusked rice, while rice refers to husked and cleaned rice.

Producer liquidity becomes important when farmers attempt to increase their gain by withholding stock at the peak of harvest and selling later. But because of immediate cash needs many farmers cannot do so unless high prices and production of cash crops enable them to pursue this profit-maximizing practice. Jute is the primary cash crop and its harvest coincides with the harvest of *aus* rice and the marketing of some *boro* rice. Therefore a high cash return from jute would mean less *aus* and *boro* rice marketed during their harvest time than would have been marketed with a lower cash return from jute. The resulting increase in stock would tend to spill over to the *aman* crop season. Thus one would expect high prices and production of jute to depress harvest season *aman* prices.

Considering the paucity of seasonal data, the following regression equation is specified to estimate the relationship discussed above:

$$SP = f(Q,R,V,T),$$

where

- SP = index of the December-January rice price in reference to the annual average taken at 100,
- Q = index of total rice production,
- R = index of December-January ration distribution,
- V = index of value of jute production; the nominal price of jute deflated by the general price index, and
- T = index of industrial production.

Total rice production (Q) provided better explanatory power than *aman* production. Monthly ration distribution data were available only for the period 1972 to 1976. The December-January ration distribution as a percentage of the annual total varied between 11.3 and 15 percent during this period. From 1964 to 1971, the December-January ration distribution was assumed to be 12 percent of the annual totals.

Industrial production is used as a suitable proxy for the interyear variation in the December-January nonagricultural income of consumers. Q is expected to pick up the effect of agricultural income.

The estimated equation is:

$$\log SP = 6.7407 - 0.4189 \log Q - 0.0996 \log R - 0.0868 \log V + 0.1071 \log T;$$

(t values) (7.958) (−2.1121) (−4.1598) (−2.4454) (1.3002)

$\bar{R}^2 = 0.67$; DW = 2.176.

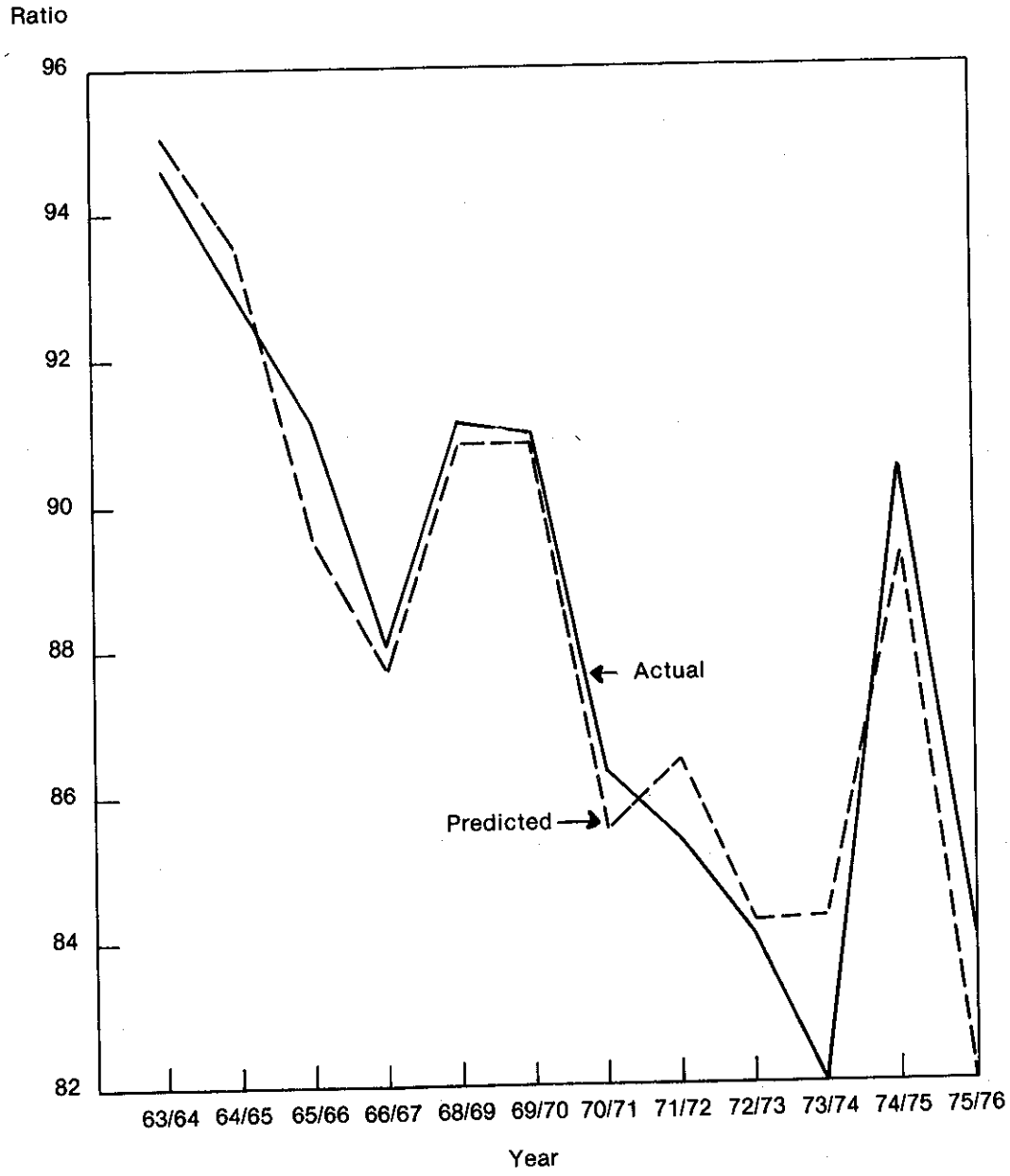
All the explanatory variables have the expected sign and all the coefficients are significant, except the one for industrial production, which is significant at about an 80 percent level. The graph of the relationship in Figure 3 presents actual and predicted values for the index of harvest prices. The equation explains the price dip in December-January quite well for the period before 1970-71; for the more recent period, however, the fit is not as good. This is believed to be the result of many other factors that upset the economy during the political turmoil of that period.

The policy implications of the equation estimated above appear clear. Reducing ration distribution during *aman* helps support harvest season prices of *aman* rice. A preliminary evaluation of rice production, prices and production of jute, and general nonagricultural activity in the country would provide some indications of the magnitude of the procurement program needed for price support purposes. This would form a better basis for advance planning of procurement than the present practice of going by an arbitrary target.

Procurement's Effect on Variability in Consumption and Trade

As a result of procurement, harvest season consumption would tend to fall

Figure 3: December-January rice price relative to annual averages: actual and predicted



as determined by the price elasticity of demand. Previous chapters have shown that the consumption levels of the poor fall faster than those of the rich when prices rise, and conversely. This implies that a wider gap between the lean and harvest season prices of foodgrain will result in a larger seasonal fluctuation in

consumption by the poor. The highest and lowest rice prices in different years are shown in Table 17.

The table shows the spread between the lowest and highest levels of rice prices slowly increasing until 1972-73. For the next three years the gap was wider; the peak level price was about 60 percent higher than the lowest price during this period, which must have caused severe seasonal fluctuations in consumption of foodgrains, particularly among low income consumers. Reducing seasonal fluctuations in consumption is considered desirable.[56]

Procurement does not ensure an automatic reduction in the gap between harvest and lean season prices. If private traders reduce their buying of rice in the harvest season by a quantity equal to the government's procurement, and if the government does not release this quantity later in the open market, procurement will, *ceteris paribus,* increase the spread between the harvest and lean season prices. Even if the government distributes the entire procured quantity through rationing, the difference between the lean and harvest season prices will still be larger because of the income effect of rationing. The wide spread between lean and harvest season prices presented in Table 17 indicates that procurement did not substantially reduce the apparent incentives for the private trade during the last three years. Other factors discussed earlier, such as production, ration distribution, farmer liquidity, and income only partly explain the unusual price fluctuations during the postliberation period.[57] This leads to the conclusion that private traders must have had serious inhibitions about entering the market during this period. Insecurity in business transactions within an environment of extreme lawlessness, disruptions in transportation, and weak financial institutions probably raised the cost of private trade substantially.

It may be concluded that stabilizing seasonal fluctuations of foodgrain prices is a desirable objective that can help improve the nutritional status of poor consumers. Combined with its distribution program, government procurement can play an effective role in this regard. However, if, as is likely, private trade is more efficient (in lower marketing cost) than public procurement in damping price fluctuations, the government's stabilizing role should not be expanded to the point of seriously restricting private trade.

Figure 4 represents the percentage deviations of monthly prices from the annual average. Assuming that the seasonal fluctuations in prices during the late sixties provided an adequate return for private trade, the graph suggests that government procurement should not reduce the spread between the annual average and the harvest season price below 8 to 12 percent.

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[56] Strictly from the point of view of economic principles, and assuming a declining marginal utility from consumption of foodgrains, the total utility derived from a given quantity of foodgrains will be higher if consumption is evenly distributed over the year than if more is consumed in the first half and less is consumed in the second half of the year. This may also be true of the technical relationship between nutrition and distribution of food intake within a consumption period. Seasonal variations in activity levels and energy requirements do not seem to be consistent with variations in seasonal supplies of foodgrains. For example, the harvesting and threshing of *aman* rice constitute only about 30 percent of the total labor requirement for growing the crop; the other 70 percent of the total labor requirement falls within the period of July-September, when price levels are generally high. See Raisuddin Ahmed, "Economic Analysis of Tubewell Irrigation in Bangladesh," (Ph.D. dissertation, Michigan State University, 1972). Energy requirements of the nonagricultural labor force are more evenly distributed over time than those of the agricultural labor force, because nonagricultural activities are less seasonal. This suggests that a reduction in seasonal fluctuations of foodgrain prices is desirable for improving the nutritional status of consumers (workers), and perhaps also for increasing the productivity of labor.

[57] The relatively small spread between peak and low price in 1972-73 can be attributed to the largest public distribution of foodgrains in the face of a small domestic production, so that the private trade had very little of a stabilizing role.

Table 17—Normalized lowest and highest levels of wholesale rice prices, 1960/61 to 1975/76

Years	Highest Price	Lowest Price	Difference	Highest Price as Percentage of Lowest Price
	(Tk/maund)	(Tk/maund)	(Tk/maund)	
1960-61	32.28	26.67	5.61	121.0
1961-62	28.84	23.58	5.26	122.3
1962-63	28.90	24.97	3.93	115.7
1963-64	33.04	25.88	7.16	127.7
1964-65	27.55	22.68	4.87	121.5
1965-66	31.85	24.66	7.19	129.2
1966-67	50.76	37.81	12.95	134.3
1967-68	43.90	34.71	9.19	126.5
1968-69	n.a.	n.a.	n.a.	n.a.
1969-70	50.99	38.73	12.26	131.7
1970-71	46.32	35.06	11.26	132.1
1971-72	45.32	33.40	11.92	135.7
1972-73	78.67	56.79	21.88	138.5
1973-74	99.17	65.13	34.04	152.3
1974-75	253.81	157.57	96.24	161.1
1975-76	224.09	136.90	87.19	163.7

Sources: Based on prices from M. Raquibuz Zaman and M. Asadirzzam, *An Analysis of Rice Prices in Bangladesh, 1951-52 to 1967-68* (Dacca: Bangladesh Institute of Development Economics, July 1972) and various price publications of the Bangladesh Bureau of Statistics.

a Prices have been normalized to remove the effects of an upward trend over time by deflating monthly nominal prices.

Fixing Procurement Price

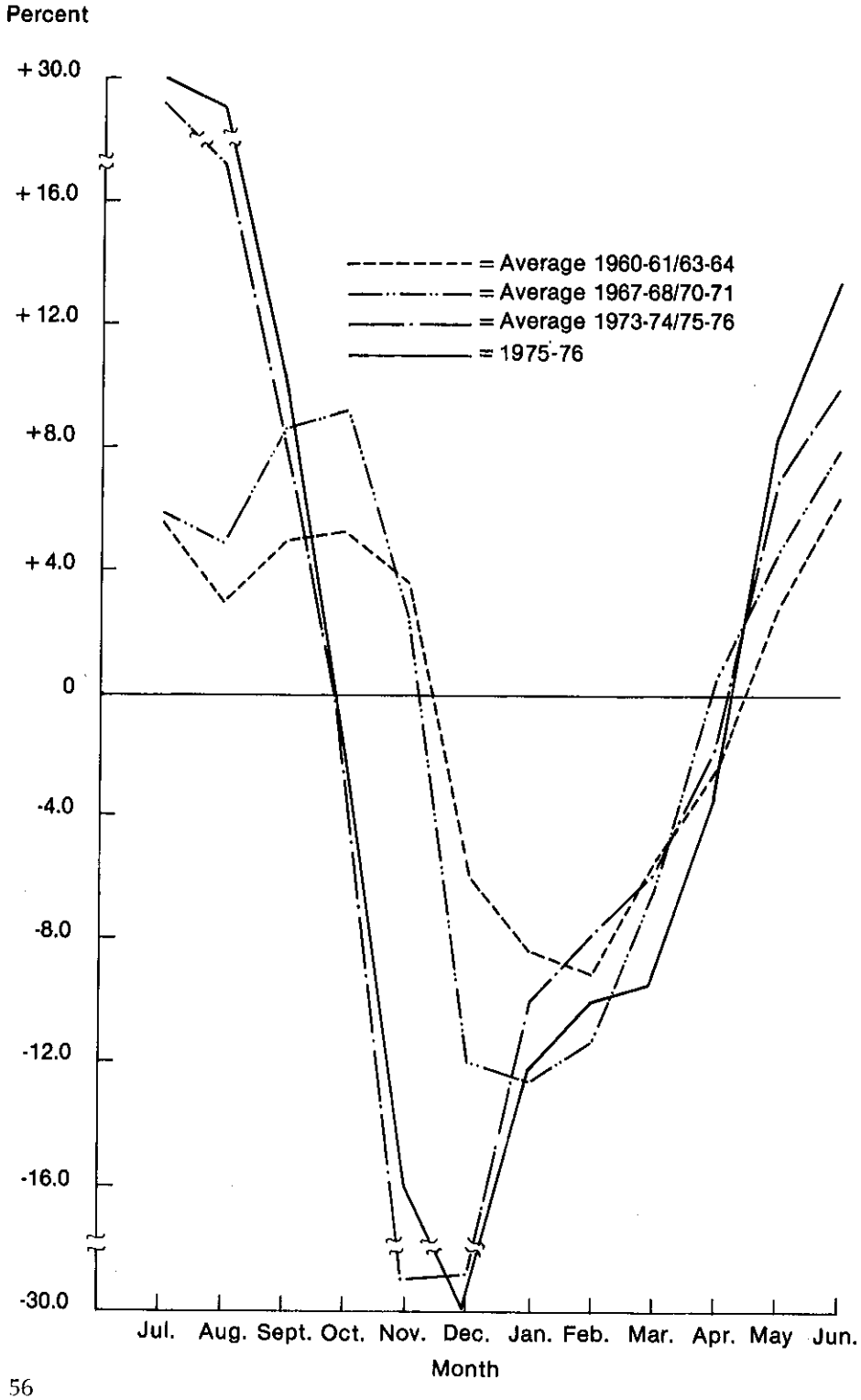
The prevailing practice of fixing the procurement price is based on two criteria: providing incentives to rice producers to increase production and maintaining a desirable balance between jute and rice acreage.[58] The first criterion is generally applied by comparing a proposed procurement price with estimates of the cost of production, while the second implies a jute-rice price ratio that maintains a desirable balance between jute and rice acreage.

The relationship between jute acreage and the ratio of jute price to rice price was significantly positive.[59] As a result of a rising rice price relative to jute price and a declining jute yield, jute area declined

[58] The government pursues a policy of keeping the jute-paddy price ratio around 1.5. The ratio of procurement price of jute to procurement price of paddy in 1975-76 was about 1.4.

[59] A. K. M. Ghulam Rabbani, "Economic Determinants of Jute Production in India and Pakistan," *Pakistan Development Review* 5 (Summer 1975): 37-49. See also Raisuddin Ahmed, "Foodgrain Production in Bangladesh: An Analysis of Growth, Its Sources and Related Policies," and Raisuddin Ahmed, *Foodgrain Production in Bangladesh: An Analysis of Growth and Related Policies* (Dacca: Bangladesh Agricultural Research Council, 1977).

Figure 4: Percent deviation of normalized monthly prices from annual averages



to the lowest level in history by 1975-76. To maintain the desired balance between jute and rice acreage,[60] the government set a jute-paddy price ratio of 1.5 as the policy target needed. Given the nature of international demand for jute, this ratio implies an average paddy price of Tk 93 per maund (Tk 145 per maund of cleaned rice), roughly equal to the prevailing price of coarse rice in 1975-76. Anything above Tk 145 per maund would tilt the balance away from jute.

Estimates of production costs for rice are not made regularly in Bangladesh. The government generally uses estimates based on information generated by occasional field surveys of the Agroeconomic Unit under the Ministry of Agriculture.

This analysis uses the per acre costs of production of different varieties of paddy for 1968-69 estimated by the Ministry of Agriculture and for 1975-76 collected through small samplings by the U.S. Agency for International Development in Dacca. Methods used to derive the two sets are quite similar. In both cases costs represent only direct items (excluding rents, etc.), and on-farm inputs are valued at market rates. While studies were made for an owner-operated farm, in this study the costs are for both owner and tenant farm situations. These estimates indicate that for owner-farmers the ratio of procurement price to average cost ranges from 2.42 to 3.11 for high yielding varieties (HYV) and from 2.1 to 3.0 for local varieties. However, for sharecroppers the ratio ranges from 1.05 to 1.51 for local varieties, and from 1.21 to 1.56 for HYV.

These estimates do not take into consideration the risk inherent in growing different varieties of rice. *Aus* rice is the riskiest crop, followed by *aman* and then *boro* rice. If the cost of the risk could be included, perhaps *boro* would be the most attractive in terms of profitability.

In conclusion, the 1975-76 procurement price of Tk 74 per maund appears to provide substantial incentive under normal crop conditions to most farmers. But the incentive to tenant farmers, mostly subsistence farmers for whom procurement price may have little significance, appears to be less attractive, particularly in the case of local *boro* rice.

Procurement Price and Fertilizer Use

The relationship between procurement price and fertilizer use raises two points: whether the output price relative to the input price provides incentive to expand use of fertilizer, and whether it would be more socially efficient to spend a given amount of scarce budgetary resources on input subsidy or on price support measures. The first point will be discussed here, and the second will be analyzed in the next chapter. Table 18 presents estimates of the marginal products of fertilizers and compares the value of these marginal products with fertilizer price using the procurement price of paddy.

The ratio of the value of the marginal product of fertilizer to fertilizer price indicates a highly attractive incentive for the use of fertilizers, particularly on owner-operated farms and in *boro* rice crops. The incentive is relatively small in *aus* rice under sharecropping, however.

[60] No attempt is made to analyze this relationship further in this paper, because extensive research has gone into the formation of government policy in this respect.

Table 18—Procurement price and incentive for fertilizer use

Rice Crop	Marginal Physical Product (MPP) of Fertilizer	Value of Marginal Product[a]	Fertilizer Price (1975-76)[b]	Ratio of Product Value to Fertilizer Price	
				Owner	Sharecropper[d]
	(paddy/nutrient)	(Tk)	(Tk/maund of nutrient)		
Boro	10.0	629	122	5.2	2.6
				(4.5)[c]	(2.2)
Aman	9.5	598	122	4.9	2.5
				(4.3)	(2.1)
Aus	7.5	472	122	3.9	1.9
				(3.4)	(1.7)

Source: MPP from: Raisuddin Ahmed, *Foodgrain Production in Bangladesh: An Analysis of Growth, Its Sources and Related Policies* (Dacca: Bangladesh Agricultural Research Council, 1973).

[a] Procurement price is assumed to be 85 percent effective at farm level.

[b] Weighted average price of nitrogen, phosphorus, and potassium.

[c] The figures in the brackets are ratios incorporating a credit cost at 30 percent annual interest on fertilizer price for six months.

[d] Sharecropping in Bangladesh generally necessitates that input costs be borne by the sharecropper.

7

PRICE SUPPORT VERSUS FERTILIZER SUBSIDY FOR INCREASING RICE PRODUCTION

Although the need to augment aggregate availability of foodgrains in Bangladesh is an acute long-run problem, some of the aspects of production in the short run deserve examination. This chapter examines the relative merits of two policies designed to increase domestic production of rice: price support and fertilizer subsidy. Using a framework that outlines the interrelationships among important variables, the analysis evaluates the impact of the two policies on producer and consumer incomes, government budgetary burden, foreign exchange savings, and distribution of benefits. These two policies are not meant to represent the full range of options available to Bangladesh; nor are they mutually exclusive. They are alternatives only in their competition for the government's scarce budgetary resources, and thus illustrate the need for the government to consider the opportunity costs of its policy decisions. A decision on the level of price support for rice, insofar as it requires a subsidy to sustain it, should be made in light of the effects the same subsidy would have if offered through a reduction in fertilizer prices.

Efforts to increase foodgrain production are heavily dependent on the area under irrigation and the use of high-yielding varieties, the role of fertilizer in the increase of production has assumed special importance. The present level of fertilizer application in rice is very low: about 36 pounds per acre (16.5 pounds in terms of the nutrients). Rice crops account for about 88 percent of the total fertilizer consumption in the country.

With varying degrees of effectiveness, government has provided support prices for rice and subsidized prices for fertilizers. Before 1973, 65 percent of the cost of fertilizer was subsidized. Since the formation of the 1972-73 development budget, further subsidies have gradually been reduced. In 1974-75, there was no subsidy on urea fertilizer and the overall rate of subsidy on all fertilizers was about 27 percent.

The price support policy involves government paddy procurement at a given price at harvest time. Before 1974-75 government procurement was not a mechanism for substantial price support, but during 1976-77, procurement price and mechanism were set to provide substantial incentives to producers. During this process of reorientation of the procurement program, policy makers realized that the price support and the fertilizer subsidy programs, both designed to provide incentives to increase production, could not be considered separately. In fact, during the formulation of the 1976-77 development budget, the question whether to reduce fertilizer subsidy and provide a higher effective support price for foodgrains or to increase fertilizer subsidy and relax price support for foodgrains turned out to be an issue of intense debate among policy makers.

It should be clarified that certain stabilization policies, such as buying rice when the price falls unusually low at the harvest season of a good crop and selling during the lean season without involvement of government subsidy, would not be considered price support alternatives

to fertilizer subsidy. The difference is subtle but nevertheless important.

A basic assumption of the analysis is that price incentives alone cannot cause a large increase in production. Other ancillary policies designed to improve technology and the supply of modern agricultural inputs are essential for this purpose. The analysis is therefore limited to short-term effects.[61]

A Framework

Among the criteria considered appropriate for evaluation of price support versus fertilizer subsidy programs are social benefits, budgetary burden, foreign exchange savings, and distributional implications. The social benefit measure can incorporate budgetary burden and foreign exchange effects to provide a single criterion, but distributional implications are too complex for collapsing into a single criterion and are therefore presented separately. These measures are defined as:

1. Total social benefit = Producer benefit + Consumer benefit + Increase in government revenue + Premium on foreign exchange savings;
2. Net social benefit = Total social benefit − Direct government cost; and
3. Net government cost = Direct government cost−Government revenue.

The values of these measures are estimated employing the model designed by Barker and Hayami[62] for developing market economies. The Barker-Hayami model is modified to accommodate the jute-rice acreage substitution arising from the changes in their relative prices and the practice of supplying all imported rice through the rationing system.[63] It is presented in Figures 5 and 6.

In Figure 5, SS represents the domestic supply curve of rice at the existing prices of fertilizers. The vertical line DhH represents the demand curve of producers for home consumption. Total demand is represented by DhmD, and the horizontal distance between DhmD and DhH measures the quantity marketed.[64] DhH has been drawn as insensitive to prices on the basis of studies in subsistence economies like India and the Philippines.[65]

The initial situation in Figure 5 shows a market price of Pd; at this price quantity OQo of rice is consumed at home and from the free market. An additional quan-

[61] The scope of the analysis is narrow in the sense that the comparison is limited within the alternatives of price support and fertilizer subsidy, although it involves a broader question of resource allocation, which embraces a large number of alternatives. Since the focus of the study is on short-run policies and since fertilizer is a crucial input for increasing production in the short run, the comparison, even this narrowly focused, is considered relevant.

[62] Randolph Barker and Yujiro Hayami. "Price Support Versus Input Subsidy for Food Self-Sufficiency in Developing Countries," *American Journal of Agricultural Economics* 58 (November 1976): 617-628.

[63] One basic assumption of the model is that a reduction in fertilizer prices does not significantly affect the use of other inputs, particularly labor, which is the important factor of production in rice (after land). Since the complementary and competitive relationships among factors are highly complex, it makes identification of the direction of possible bias difficult. Other assumptions will be clarified as we proceed with the operational description of the model. We consider only rice and jute, which account for about 92 percent of the total fertilizer consumption.

[64] The demand curve representing the marketed quantity, not drawn separately, would run parallel to the total demand curve at its left at a distance equal to the difference between DhmD and DhH.

[65] Availability of a close substitute for rice in the consumption and cropping combinations of farmers largely determines the degree of sensitivity of home consumption to changes in market prices. Comparative analysis in South and Southeast Asian countries show that the contribution of rice to total nutritional intake is highest in Bangladesh (Food and Agriculture Organization of the United Nations, *The Fourth World Food Survey* [Rome, 1977]), indicating a relative scarcity of substitutes for rice. This would imply a highly inelastic demand curve for home consumption. See Toguero Zenaida, et al., "Elasticity of Home Consumption and Marketable Surplus for a Subsistence Crop: Rice in the Philippines" (Los Banos: International Rice Research Institute, 1975).

Figure 5: Model of price support and fertilizer subsidy for rice

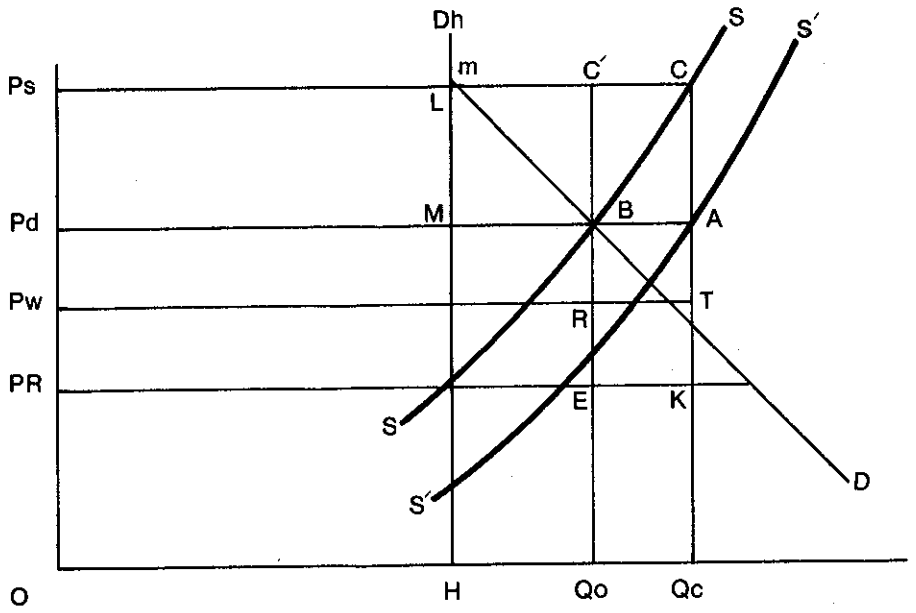
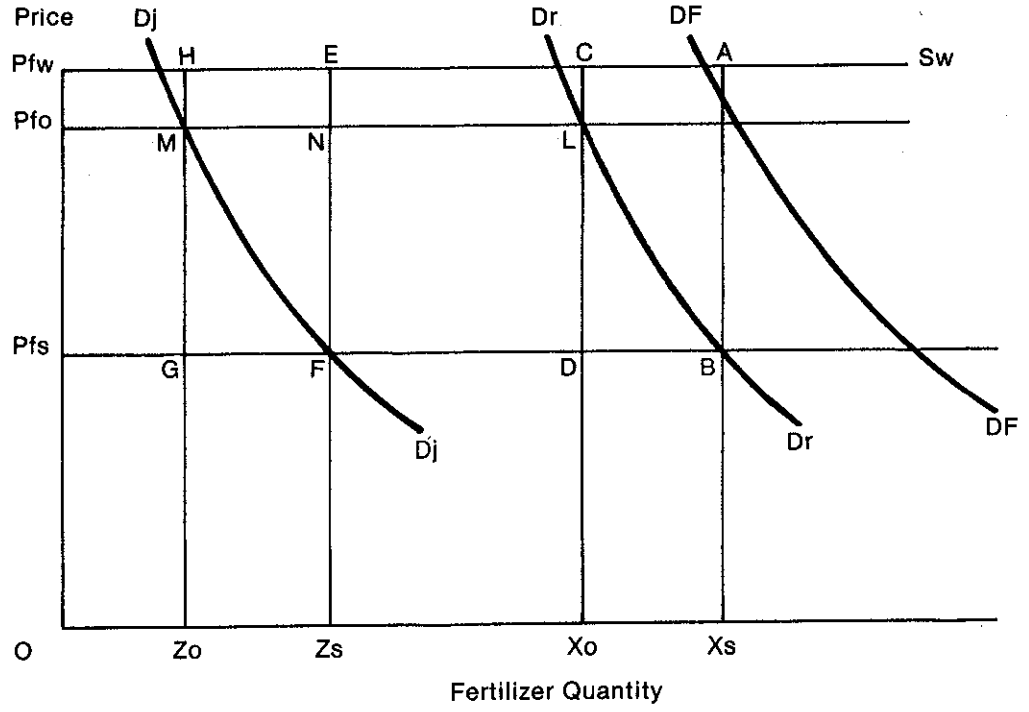


Figure 6: Model of fertilizer demand and supply



tity (Qc-Qo) is imported and distributed through rationing. Domestic production can be substituted for this quantity of imports by raising the producer prices to PS or by shifting the supply curve to S'S' position by reducing fertilizer prices. In evaluating those policies, it is assumed that the government maintains the market price of rice at the initial level (Pd) when implementing either program. Under the fertilizer subsidy program, the market price at Pd is maintained simply through procurement of AB quantity for the rationing system. The level of Pd represents 1976 average price of retail medium quality rice. In real terms, it is roughly equivalent to 1969-70 levels of rice prices.

Except in 1973-74 and 1974-75, domestic rice prices have been above international prices (PW). However, ration prices (PR) have always been below PW. Replacing imports with domestic production for rationing would imply a net increase in subsidy cost for rationing.

The data and estimated formulations of the criteria measures, with exact algebraic formulations, appear in Appendix 4. A brief explanation of the geometric version of the model is included here.

Rice Price Support

Assuming a fixed domestic supply schedule (SS), an increase in the production of rice to the level of OQc can be achieved by supporting the producer price at OPS. Since the government maintains the consumer price at OPd, the increase in the production of rice would involve a cost to the government represented by area ACLM, the difference between the procurement cost and the sales revenue. In addition, import substitution of quantity AB of rice would result in an increase in ration subsidy (negative government revenue) by area ABRT.

With the support price at OPS, producer revenue from the sale of rice would increase by area ACLM plus area QcABQo. Area BCLM represents an increase in the income of rice producers at a cost to the government. Consumer welfare does not change, because neither Pd nor PR is changed.

A net foreign exchange savings in the rice sector is the area QoRTQc minus the foreign exchange cost of the increased importation of fertilizers, which is caused by heavier application of fertilizer stimulated by a more favorable ratio of fertilizer price to rice prices.

The rise in rice price will cause a reduction in jute acreage in response to the shift in relative rice-jute prices. The loss of income and foreign exchange earnings resulting from the reduction in jute production, as determined by the supply and demand elasticities of jute, must be deducted from gains in the rice sector to arrive at the net social effect of policies to support rice prices.

Fertilizer Subsidy for Rice

According to Figure 5, the desired increase in the production of rice can be achieved without supporting the producer price by shifting the supply curve from SS to S^1S^1. Because the supply curve represents a marginal cost curve, it can be shifted to the right by lowering the price of inputs.

Given the production elasticity of fertilizer in rice production, we can determine how much fertilizer must be applied to obtain the target increase in output. Then, knowing the price elasticity of demand for fertilizer, we can calculate the decline in price that will induce the required additional fertilizer consumption.

A model of the fertilizer market is shown in Figure 6. The demand curves for the rice (DrDr) and the jute (DjDj) sectors add horizontally to yield the total demand curve (DFDF). The supply curve SW is assumed to be infinitely elastic at the world price level. Consideration of an upward sloping domestic supply curve has been avoided because it might involve subsidization of the fertilizer industry

rather than of farmers.

If the price of fertilizer applied to rice must be subsidized at Pfs to achieve the increased production target, the government fertilizer subsidy to rice is represented by the area ABPfsPfw in Figure 6. The increase in ration subsidy (negative revenue) because of a decrease in rice imports as a result of increased domestic production remains the same as in the case of price support of rice.

Rice producers would receive a dual benefit from being able to buy all their fertilizer at a lower cost as represented by the area LDPfsPfo (Pfo is the present farm level price for fertilizer) in Figure 6, and from the increased output value, area ABQoQc in Figure 5 minus fertilizer cost, from using additional fertilizer because of the more favorable price relationship, area BDXoXs in Figure 6.

Net savings in foreign exchange can be shown as the net reduction in foreign exchange expenditures for rice imports, area RTQoQc in Figure 5, minus the increase in foreign exchange required for increased fertilizer imports, area ACXoXs in Figure 6, if the entire additional quantity of fertilizer is imported. As with rice price support, the welfare of rice consumers does not change, because they consume the same quantity of rice at the same price irrespective of the support or subsidy programs.

A reduction in fertilizer price will induce farmers to increase their use of fertilizer on jute by the quantity ZoZs, expanding jute production as determined by the production elasticity of fertilizer. Like rice growers, jute producers would benefit in two ways: lower cost on the amount of fertilizers they already use, represented by area MGPfsPfo in Figure 6, and increased income equal to the value of the increased jute production minus the cost of additional fertilizer used on jute. The government subsidy to the jute sector is represented by the area EFPfsPfw in Figure 6. The only foreign exchange implications in the jute sector are the increased amount of fertilizer (ZoZs) used on jute and the increased jute export.

The impact of the subsidy program will be the net result of all of the above pluses and minuses in the jute and rice sectors with respect to producer income, government subsidy, and foreign exchange.

Parameters and Data

From the graphic analysis thus far, it is clear that the net impact of the price support and fertilizer subsidy programs will depend on the underlying demand and supply parameters. This section presents those parameters and the data required for calculating the net impact of the two policies. Appendix 4 provides an explanation of why each of these values has been chosen and likewise presents the calculation procedure, including the mathematical approximation formula.

The average of 1974-75 and 1975-76 was used as a base year to represent the normal situation in the recent past. The analysis incorporates the following base year values and other data:

1. Targeted increase in domestic production of milled rice: 500,000 tons;
2. Marketed quantity: 29 percent of production;
3. Base year jute production: 907,000 tons;[66]
4. Fertilizer use: 439,000 tons, 88 percent on rice, 3.4 percent on jute. Nitrogen, phosphate, and potassium in the proportion 70:25:5. Distribution cost has been estimated at 25 percent of c.i.f. value;
5. Domestic retail price of rice: Tk 146 per maund;
6. Farm level jute price: Tk 90 per maund; export price: Tk 192.5 per

[66] Because 88 to 90 percent of jute production is exported, changes in jute production are assumed to affect exports in the same amount.

maund; tax rate on raw jute exports: Tk 303 per ton;

7. Farm level cost price of imported fertilizer: Tk 94.5 per maund; present sale price of fertilizer to farmers: Tk 56 per maund;
8. Price elasticity of rice production:[67] 0.18;
9. Price elasticity of demand for fertilizer: −0.50;
10. Production elasticity of fertilizer (percentage change in production because of a percentage change in fertilizer application): 0.104 for rice and 0.06 for jute;
11. Price elasticity of jute production: 0.25;
12. Export demand for Bangladesh raw jute is assumed to be infinitely elastic; and
13. The foreign exchange premium is assumed to be 7 percent on the basis of an estimated exchange rate following the purchasing power parity theory and using the general price index in Bangladesh and the United States.

Evaluation of Policy Alternatives

Table 19 presents quantitative estimates for evaluating the two alternative programs. The first two columns are derived under the assumptions discussed in the text; the two other pairs of columns contain results under alternative assumptions. Under the initial set of conditions, the benefit to producers is substantial under both the programs, but the net social benefit is negative for the price support program. Low price elasticity of rice production, substitution of rice acreage for jute, and domestic production of fertilizers—all contribute to the relative superiority of the subsidy policy over the price support policy. The budgetary burden of the price support policy appears to be about 3.5 times heavier than that of the fertilizer subsidy policy. With the same set of initial parameter values, the fertilizer subsidy program also was found to be superior to price support programs in terms of foreign exchange savings. However, the producer benefit under the price support program is about 58 percent larger than that under the fertilizer subsidy program.

Sensitivity of the Results

In order to see the changes in results, the price elasticity of rice production, fertilizer prices, and the demand elasticity of fertilizers are changed. These three parameters are chosen because they strongly influence the results and because a certain degree of controversy surrounds the appropriate value to choose as a result of recent structural changes. It has been argued that postindependence development in agriculture in Bangladesh, particularly the 1974 crisis and changes in seed-fertilizer technology, has increased the degree of commercialization among larger farmers.[68] The estimates indicate that market-oriented production would be more responsive to product price than in the past. To test the implication of a higher supply elasticity, we raised the value of the supply elasticity from 0.18 to 0.3. A higher value is unlikely in the short run.

Fertilizer prices in the world market rose sharply during 1974-75, although they have come down rapidly since then. To analyze the implication of a sharp rise in fertilizer prices, we have set an alternative price level for fertilizer 30 percent higher than the price originally assumed. Though the initial value of price elasticity of demand for fertilizers is considered realistic, we select the alternative value of −0.35 to see the changes in results.

The results of the above changes are

[67] Defined as the percentage increase in rice production resulting from a percentage change in rice price.

[68] E. J. Clay, "Institutional Change and Agricultural Wages in Bangladesh," *Bangladesh Development Studies* 4 (October 1976): 423-440.

Table 19—Estimated benefits and costs of price support and fertilizer subsidy programs to raise rice production by 500,000 tons

Criterion	Price Elasticity of Rice Supply is 0.18, Price Elasticity of Fertilizer Demand is −0.5		Price Elasticity of Rice Supply is 0.3, Price Elasticity of Fertilizer Demand is −0.5, and Fertilizer Prices are Increased by 30 Percent		Price Elasticity of Rice Supply is 0.3, Price Elasticity of Fertilizer Demand is −0.35 and Fertilizer Prices are Increased by 30 Percent	
	Price Support	Fertilizer Subsidy	Price Support	Fertilizer Subsidy	Price Support	Fertilizer Subsidy
	(million Tk)					
Total social benefit	2,907	1,878	1,691	1,874	1,692	1,988
Net social benefit	−1,302	692	−714	212	−713	209
Producer benefit	2,891	1,827	1,661	1,827	1,661	1,942
Government revenue	−103	−82	−97	−82	−97	−82
Direct government cost	4,209	1,186	2,405	1,662	2,405	1,779
Net government cost	4,312	1,268	2,507	1,744	2,507	1,861
Foreign exchange savings	1,703	1,899	1,819	1,839	1,825	1,834

[a] Government revenues would fall because of the export tax on jute and the reduction of imports caused by substituting domestically produced foodgrains for imports.

presented in the last four columns of Table 19. Net social benefit of the price support program increases substantially under the changed assumptions, but it remains negative. The higher value of the supply response parameter cuts the government cost and the producer benefit of the price support program by about 43 percent. Foreign exchange savings from the price support program rise by only about 7 percent as a result of changes in the assumptions.

Assumptions of higher fertilizer prices and a lower price elasticity of demand for fertilizers reduce the net social benefit of the fertilizer subsidy program by about 69 percent, although the net social benefit is still positive. The direct government cost of fertilizer subsidy increases by 40 to 50 percent for the changed parameter values. The higher fertilizer price does not affect the producer benefit, but increases the net government cost of the subsidy program. However, a lower value of price elasticity of demand for fertilizers causes a small increase in producer benefit as well as in direct government cost.

Implications for Distribution

The previous discussion shows that disregarding which assumptions are used, the price support program favors producers at the cost of the government. The question of distribution of income among different size farms is more important in Bangladesh. To obtain a broad picture of distribution, all farms are classified into three groups: small (less than three acres), medium (three to less than five acres), and large (five acres and more).

An estimate of the relative shares of the three size groups in the producer income under the two alternative policies is presented in Table 20. The estimate is based on the following assumptions:

1. Producer income from rice under price support is distributed among different groups according to the proportions of marketed quantities in each group (see Table 24, Appendix 2). Income from jute is distributed according to the proportion of cultivated land in each group.
2. All groups pay the same prices for fertilizer and receive the same support prices for rice. If there is discrimination against any group, it is equally prevalent under both programs.
3. Producer income under the fertilizer subsidy program is distributed according to proportions of fertilizer used by different groups.

Based on limited information, it is known that, generally, small farmers pay a higher price for fertilizers than large farmers. But it is also known that small farmers benefit less from the price support program than large farmers.[69] The market structures, dealers, purchasing centers, and operating rules that underlie both price support and fertilizer distribution are such that both programs could possibly be considered equally discriminatory to small farmers. So long as the analysis is limited to the relative rather than absolute merits of the two programs, the assumption of equal access to price does not appear to be severely restrictive.

Excluding tenurial relations from the analysis implies an overestimation of the share of small farmers in income under the fertilizer subsidy program, if the small farm group includes a larger proportion of tenants.[70] However, this would be true only for sharecropping, not with other forms of tenancy.[71]

Incorporation of tenurial relations in the analysis becomes difficult because neither the agricultural censuses nor the Master Surveys of Agriculture provide data showing tenanted land by types of tenancy arrangements among various size-classes.

Although this limitation renders the results in Table 20 somewhat inconclusive,

Table 20—Distribution of producer income under price support and fertilizer subsidy policies

	Price Support		Fertilizer Subsidy	
Farm Size	Shares in Producer Income	Farms as Percent of Total	Shares in Producer Income	Farms as Percent of Total
	(percent)		(percent)	
Less than 3 acres	6.5	64.25	33.3	64.25
3-5 acres	10.5	18.76	24.3	18.76
5 acres and above	83.0	16.99	42.4	16.99
Total	100.0	100.00	100.0	100.0

[69] International Bank for Reconstruction and Development, *The Bangladesh Report.*

[70] Bangladesh Bureau of Statistics, *Master Survey of Agriculture 1967-68.* This survey does not show substantial differences in the proportions of tenanted land under various size groups.

[71] Even then, it would be more realistic to assume that a farmer would apply fertilizers only on his own portions of land under tenancy arrangements other than sharecropping, if he alone pays for the fertilizers.

it is unlikely that the direction of distributional impact of the two alternative policies would substantially change even if one could incorporate tenurial relations in the analysis.

Conclusions

This chapter has examined the relative efficiency of price support and fertilizer subsidy policies in increasing production of rice by half a million tons.

The results show that the total social benefit is substantial and positive under both programs, but that the net social benefits are negative for the price support program. The low price elasticity of rice production, substitution of rice acreage for jute in a tight land supply situation, and a high degree of self-sufficiency in fertilizers, all contribute to the relative superiority of fertilizer subsidy policy over price support policy. The budgetary burden of the price support policy appears to be heavier than that of the fertilizer subsidy policy. In years of high fertilizer prices, such as in 1974-75, the government cost of the fertilizer subsidy program may increase to the extent that it is no longer superior to the price support program.

The distributional implications of the two policies, although somewhat inconclusive because of inadequate data, tend to show that fertilizer subsidy is more egalitarian that the price support policy.

To increase rice production by half a million tons only through an increased use of fertilizer would require reducing fertilizer prices from their present level of Tk 56 per maund (weighted average for all kinds of fertilizers) to about Tk 25 per maund. This policy would still be socially profitable, although it would require a substantial budgetary allocation for fertilizers.

However, if there were a constraint in fertilizer supply caused by an increase in demand at present fertilizer prices, the policy implication then would be to allocate budgetary resources for price support to remove this fertilizer supply constraint.

APPENDIX 1
INCOME CATEGORIES FOR DISTRIBUTION OF RATION FOODGRAINS

In estimating the quantities of ration foodgrains received by each income group, it is assumed that ration quotas were drawn by all cardholders. It is also assumed that the incidence of false ration cards, if any, is proportional to the size of the various income classes. Occasional house-to-house checks have established the existence of false ration cards, and aggregate data corroborate this fact. The 1973-74 population in the statutory rationing area accounted for a total of 445,000 tons of foodgrains, assuming all cardholders took their quota. Actual distribution, on the other hand, was recorded as 502,000 tons during this year. Assuming that the census population statistics are correct, the divergence means that 11.4 percent of the total statutory ration was lifted through false ration cards.

The income classifications and percentages of population in various urban and rural income groups reported in the 1973-74 Household Survey were the basis of the analysis. The analysis examined two types of allocations: allocations between rural and urban populations, and allocations among income groups. Statutory rationing is limited to five cities, and therefore entirely allocated to the urban group. Modified rationing is meant for both urban areas outside the statutory areas and rural areas. The analysis allocates modified rationing between urban and rural areas on the basis of actual data from the Mymensingh district, the largest district in the country. This indicates that about 30 percent was distributed in the urban and 70 percent in the rural areas in 1975-76. The statutory and the modified categories together constitute about 80 percent of the total foodgrains distributed through rationing in 1973-74. The third largest category, government employees outside the statutory areas, was allocated between urban and rural areas in the proportion of 25 to 75, respectively. This proportion is made based on the dispersal of government employees in the Agriculture and Revenue Departments[72] in urban and rural areas within a district.

Primary school teachers and most of the private high school and college teachers included in the definition of government employees live in the rural areas. Moreover, a substantial number of government employees, those living in the five cities of statutory rationing, are excluded from this category. The quantities in the large industrial employers category are allocated in the same manner as those for government employees.

In the case of statutory rationing, the distribution among various income groups is made according to the proportion of the urban population in each. This is based on the rule of a fixed quota of ration per card for all in the statutory areas.

In allocating modified rationing in the urban areas, no taxation criteria to exclude taxpaying income groups is applied.

[72] Employees in the Agriculture and Revenue Departments were used since these government departments are the largest in Bangladesh.

Although low income groups who pay no tax are supposed to have priority access to modified rationing, it was observed in the Mymensingh town area that this rule was not being followed because of the complexities of assessing income levels. In rural areas the criterion is easier to apply because of land tax systems. The upper income groups are excluded from modified rationing in rural areas. The cut-off point is determined on the basis of income per earner in each income class as found in the Household Survey and by the legal limit of taxable income.

The quantities in the government employees category are distributed among various income groups according to the proportion of government employees in various income groups. The distribution of government employees by scales of pay was obtained from the Establishment Division of the government, and was linked to the income classifications of the Household Survey by assuming that employees are at midpoints of their pay scales.

For large industrial employers, the wage range of skilled and unskilled laborers is linked to the main income classifications. The total quantities under this category were equally divided among this limited number of classes. Although the priority category of ration is meant for jails, hospitals, and police and army personnel, most jails and hospitals are located in urban areas, a substantial part of police and army personnel (including border forces) is stationed in rural areas. This category is therefore split equally between urban and rural, and the distribution among various income groups is done in a manner similar to the case of government employees.

APPENDIX 2
SUPPLEMENTARY TABLES

Table 21—Comparison of domestic and international prices of rice, 1964-65 to 1976-77

Year[a]	International Price[b]		Domestic Wholesale Price	Ratio of Domestic and International Price
	(Tk/ton)[c]	(US$/ton)	(Tk/ton)	
1964-65	493.8	103.3	737.3	1.49
1965-66	596.0	113.95	898.6	1.50
1966-67	749.8	125.80	1,136.6	1.52
1967-68	730.7	137.60	1,053.0	1.44
1968-69	767.3	137.75	1,144.4	1.49
1969-70	698.2	115.45	1,130.2	1.60
1970-71	565.5	91.80	1,111.7	1.97
1971-72	605.1	88.60	1,377.5	2.28
1972-73	2,061.9	165.35	2,160.9	1.05
1973-74	4,820.3	349.55	2,904.3	0.60
1974-75	7,085.3	391.45	6,068.9	0.86
1975-76	3,604.3	287.65	3,760.8	1.04
1976-77	2,338.0	191.00	3,619.0	1.51

Source: Data taken from International Rice Research Institute, *World Rice Statistics* (Los Banos, Philippines: IRRI, 1976).

[a] Prices in financial years are averages of two adjacent calendar years.

[b] Refers to f.o.b. price of Thai 35 percent broken rice under government to government contract. Domestic wholesale price should be compared with the c.i.f. price which generally is 5 to 7 percent higher than the f.o.b. price.

The exchange rate is estimated using the arguments in the "purchasing power parity theory." The formula is as follows:

$$E_{tl} = E_{to}(P_{al}/P_{ao})(P_{bo}/P_{bl})$$

where Etl and Eto represent the rate of exchange in period tl and the base period, respectively, and Pa and Pb represent the level of prices in Bangladesh and the United States, respectively.

Table 22—Per capita foodgrain consumption and income, and foodgrain prices, 1960-61 to 1975-76

(Data used for model in Chapter 4)

Year	Per Capita Consumption of Grain from Market & Home	Ration Distribution		Market Rice Price	Real Per Capita Income	Ration Rice Price	Ration Wheat Price	Nongrain Food Price Index
		Rice	Wheat					
	(lb)	(lb/capita)		(Tk/maund)	(Tk)	(Tk/maund)	(Tk/maund)	
1960-61	345.4	13.9	6.0	29.30	362.5	23.75	18.12	77.5
1961-62	333.5	15.0	10.3	30.21	373.2	23.75	19.97	82.3
1962-63	298.9	18.0	19.1	32.22	363.2	23.75	12.50	84.3
1963-64	347.3	11.6	6.8	28.96	385.3	23.75	13.58	85.5
1964-65	332.5	9.0	8.9	29.80	383.7	25.40	12.40	92.6
1965-66	320.3	15.2	19.0	35.95	388.6	26.13	13.53	85.3
1966-67	286.9	14.5	17.8	46.10	389.4	28.22	18.40	93.3
1967-68	324.9	10.9	18.2	42.50	399.7	30.17	20.66	93.7
1968-69	321.9	10.3	19.8	46.23	406.2	30.80	20.38	97.3
1969-70	331.7	11.1	25.1	44.78	409.9	30.40	19.80	100.0
1970-71	300.4	13.4	25.7	45.30	394.1	30.00	20.80	106.5
1971-72[a]	—	—	—	—	—	—	—	—
1972-73	270.9	12.8	66.4	89.60	143.9	35.0	25.0	255.5
1973-74	310.8	3.6	47.2	120.50	285.8	45.0	30.0	320.3
1974-75	284.9	5.2	45.2	251.67	329.5	60.0	50.0	390.4
1975-76	308.5	14.2	32.5	153.83	345.4	80.0	60.0	356.5

Sources: Bangladesh, Bureau of Statistics, *Statistical Yearbook of Bangladesh, 1975* (Dacca, 1976): 195-295; Mahiuddin Alamgir and L.J.J.B. Berlage. "Foodgrain (Rice and Wheat) Demand, Import and Price Policy for Bangladesh," *Bangladesh Economic Review* 1 (January 1973): 25-28; Bangladesh, Bureau of Statistics, *Economic Indicators of Bangladesh*, Vol. 4 (Dacca, 1977): 18-59; and for 1975-76, data from various unpublished documents provided by the Bangladesh Bureau of Statistics and the Bangladesh Ministry of Food.

[a] Because of the controversiality of data during this war year, they have not been included.

Table 23—Foodgrain consumption elasticities by household expenditure, 1973-74[a]

Household Expenditure Group	Average Propensity to Consume	Marginal Propensity to Consume	Calorie Elasticity[b]	Expenditure Elasticity	Quantity Elasticity	Price Elasticity
(Tk/month)						
0-99	0.49	0.69	1.37	1.41	1.38	−0.68
100-149	0.50	0.58	1.05	1.18	1.03	−0.52
150-199	0.52	0.55	0.87	1.05	0.84	−0.44
200-249	0.51	0.50	0.73	0.96	0.70	−0.36
250-299	0.51	0.47	0.66	0.90	0.63	−0.32
300-399	0.51	0.43	0.57	0.85	0.52	−0.27
400-499	0.49	0.40	0.50	0.79	0.44	−0.22
500-749	0.49	0.35	0.41	0.72	0.35	−0.17
750-999	0.47	0.32	0.34	0.67	0.28	−0.13
1,000-1,499	0.45	0.29	0.29	0.64	0.22	−0.10
1,500-1,999	0.39	0.23	0.20	0.57	0.13	−0.05
2,000 and above	0.27	0.12	0.05	0.46	0.0	0.0
All Bangladesh	0.47	0.37	0.51	0.75	0.41	−0.19

[a] Based on double log-inverse consumption function.

[b] Calorie elasticity refers to all food items.

[c] Estimates of price elasticities are based on the Slutsky equation, which relates compensated and uncompensated price and cross price elasticities and income elasticity. For the deviation procedure and its empirical application see John W. Mellor, "Agricultural Price Policy and Income Distribution in Low Income Nations," World Bank Staff Paper No. 214. (Washington, D.C.: International Bank for Reconstruction and Development, 1975).

Table 24—Shares of fertilizer use and marketed quantity of rice by farm size

Farm Size	Percentage of Total Fertilizer Used[a]	Percentage of Cultivated Land[a]	Percentage of Total Marketed Quantity of Rice[b]
Less than 3 acres	33.62	23.30	7
3-5 acres	24.31	25.64	11
5 acres and above	42.07	51.06	82
Total	100.0	100.0	100.0

[a] Bangladesh, Bureau of Statistics, *Master Survey of Agriculture 1967-68*, Seventh Round (Dacca, 1969).

[b] Bangladesh, Department of Agricultural Marketing, "Survey on Paddy Sales in the *Aman* Season of 1973-74," Dacca, 1974. (Mimeographed.)

APPENDIX 3
A NOTE ON METHODS OF ESTIMATING DUPLICATION OF RURAL RATIONING

Household Budget Allocation

A household's foodgrain budget (BF_i) is given so that

$$BF_i = E_{ri} + E_{wi}, \quad (1)$$

where E_{ri} and E_{wi} are the total expenditures on rice and wheat, respectively, by a representative household in the *ith* income group—the income groups varying from 1, 2, . . . 5, in ascending order of income. The Household Survey provides quantities of rice (Q^o_{ri}) and wheat (Q^o_{wi}) consumed by different income groups. Therefore, the price per unit of rice (P^m_{ri}) and wheat (P^m_{wi}) consumed by different household groups can be estimated by dividing the E_{ri} and E_{wi} by the respective Q^o_{ri} and Q^o_{wi}. Budget equation (1) can be rewritten as:

$$BF_i = Q^o_{ri} \cdot P^m_{ri} + Q^o_{wi} \cdot P^m_{wi}$$

The initial budget equation is estimated for each representative household using the 1973-74 Household Survey data.

With access to rationing, the household allocates its foodgrain budget between ration foodgrains and market foodgrains which results in a surplus in the foodgrain budget after satisfying the original level of consumption. The surplus (S_i) can be estimated as

$$S_i = BF_i - ([Q^{rl}_{ri} \cdot P^r_r + Q^{rl}_{wi} \cdot P^r_w] + [Q^{ml}_{ri} \cdot P^m_{ri} + Q^{ml}_{wi} \cdot P^m_{wi}]), \quad (2)$$

where

Q^{rl}_{ri} = quantities of ration rice bought in the first installment by the *ith* representative household,

Q^{rl}_{wi} = quantities of ration wheat bought in the first installment by the *ith* household,

P^r_r = ration price per unit of rice,

P^r_w = ration price per unit of wheat,

$Q^{ml}_{ri} = (Q^o_{ri} - Q^{rl}_{ri})$ = quantities of market rice bought by the *ith* household in the first installment, and

$Q^{ml}_{wi} = (Q^o_{wi} - Q^{rl}_{wi})$ = quantities of market wheat bought by the *ith* household in the first installment.

Because the representative household meets the original level of consumption up to this point,

$$Q^{rl}_{ri} \leq Q^o_{ri} \text{ and } Q^{rl}_{wi} \leq Q^o_{wi}.$$

The proportion of this surplus spent on additional foodgrains is determined by the marginal propensity to consume (MPC). This is estimated from the Household Survey data using a double log inverse function

$$\log C = a + b\,\frac{1}{YR} + d\log YR,$$

where C is the expenditure per capita on foodgrain (rice and wheat) and YR is the total per capita household expenditure.

MPC of a given household is estimated to be

$$MPC_i = (-\frac{b}{YR_i} + d)\frac{C_i}{YR_i}.$$

The estimated consumption function for calculating MPC was

$$\log C = 1.809 - 17.683\frac{1}{YR}$$
$$\text{(t values) } (6.033)\ (-6.243)$$
$$+ 0.451 \log YR;\ \bar{R}^2 = 0.986$$
$$(7.638)$$

MPC_i was adjusted to include ration income, i.e:, $MPC_i = (-\frac{i}{Y_i} + d)\frac{b}{Y_i}$ where Y_i is YRi + Ysi and Ysi is the per capita ration income of the *ith* representative household. Therefore, $(MPC_i)S_i$ is the amount spent to purchase additional foodgrains, and $(1\text{-}MPC_i)S_i$ is the amount spent on additional nonfoodgrain commodities.

If ration availability of rice ($\bar{Q}^r_{ri}$) and wheat ($\bar{Q}^r_{wi}$) is greater than the first ration purchases (Q^{rl}_{ri} and Q^{rl}_{wi}), the household would undertake additional purchases from the rationing so that

$$Q^{r2}_{ri} = \bar{Q}^r_{ri} - Q^{rl}_{ri}, \text{ and}$$
$$Q^{r2}_{wi} = \bar{Q}^r_{wi} - Q^{rl}_{wi},$$

where Q^{r2}_{ri} is the additional rice purchases and Q^{r2}_{wi} is the additional ration wheat purchases.[73] The remaining surplus, i.e., the amount equal to

$$(MPC_i)(S_i) - ([Q^{r2}_{ri} \cdot P^r_r] + [Q^{r2}_{wi} \cdot P^r_w])$$

is assumed to be spent only on market rice, which is preferred to wheat.

If the above condition is not fulfilled (i.e., $Q^{rl}_{ri} = \bar{Q}^r_{ri}$ and $Q^{rl}_{wi} = \bar{Q}^r_{wi}$) then the surplus equal to $(MPC_i)\ S_i$ is assumed to be entirely spent on market rice.

Given the composition of the ration selected, this assumption appears consistent with the resulting composition of consumption after rationing. All resulting compositions of consumption show the proportion of wheat not below 28 percent, which is close to the original compositions before rationing. The determinants of the composition of foodgrain consumption could be numerous and complex and the Household Survey data for a single year would not yield any dependable relationship in this regard.

The quantity of additional market rice purchased (Q^{m2}_{ri}) using the amount (MPC_i) S_i is estimated as follows:

$$(Q^{m2}_{ri}) = \frac{(MPC_i)\,S_i}{\bar{P}^m_{ri}}$$

where $\bar{P}^m_{ri}$ is obtained by extrapolation of the relation between Pm and YRi. The adjustment in market price for each household is required in order to account for the observed quality differences in foodgrains (therefore differences in prices) among income groups. Thus total rice consumption is equal to $Q^{rl}_{ri} + Q^{r2}_{ri} + Q^{ml}_{ri} + Q^{m2}_{ri}$; total consumption of wheat is equal to $Q^{rl}_{wi} + Q^{r2}_{wi} + Q^{ml}_{wi}$; and domestic procurement (DP) is equal to MPO − MP, where MPO is the initial market purchase and MP is the final market purchase.

Sources of Supply

Imports for the proposed rural rationing are ration quantities minus domestic procurement. In the case of wheat, the initial market purchase was about 133,000 tons and ration wheat was estimated to be about 250,000 tons. The remaining wheat consumption under the five income classes came mainly from works program sources. All rice was assumed to be purchased from market in the initial position.

[73] When the ration availability of rice and wheat ($\bar{Q}^r_{ri}$, $\bar{Q}^r_{wi}$) is greater than or equal to the initial levels of consumption of rice and wheat (Q^o_{ri}, Q^o_{wi}), the purchases from the open market in the first installment (Q^{ml}_{ri} and Q^{ml}_{wi}) would be zero.

APPENDIX 4
DATA AND ESTIMATION FORMULAS FOR CHAPTER 7

Parameters and Data

The parameters and data required for calculation of the producer income, government subsidy, foreign exchange implications, and the magnitude of the price support and subsidy programs involved are briefly described below.

World Prices of Rice: These prices, c.i.f. Chittagong, are based on quotations for 25 percent broken f.o.b. Bangkok plus shipping charges. The Chittagong price of rice climbed from US$ 140.70 per ton in 1969-70 to about US$ 490 per ton in 1974-75. Prices came down to about US$ 200 per ton by the end of 1977. This is taken as the normal level of world rice price. On this basis, the c.i.f. Chittagong price of imported rice is Tk 112 per maund at the official exchange rate of $1 = Tk 15. Taking into account the estimated marketing cost of about 24 percent of retail, the retail price of imported rice would be about Tk 146 per maund.

Jute Price: The announced minimum price of raw jute at the farm gate, supported at the farm level, varied from Tk 85 to 100 per maund for average quality jute. We assume Tk 90 per maund as the farm level price. The export price f.o.b. Chittagong) for raw jute in 1976-77 was about US$ 344 per ton (Tk 192.5 per maund). The tax rate on raw jute export is assumed to be Tk 303 per metric ton.

Prices of Fertilizers: At present Bangladesh meets its requirement of nitrogenous fertilizers from domestic production and imports almost all of its phosphatic and potassic fertilizers. Even though the government is in the process of constructing a urea factory in Ashuganj, it will be some time before it will be completed. Thus the present fertilizer supply pattern is likely to persist in the near future.

To avoid confusion between a subsidy to farmers for fertilizer and a subsidy to the fertilizer industry, world prices for fertilizers are used as a proxy for ex-factory cost of domestically produced fertilizers. The current world price f.o.b. U.S. [gulf], Japan, Canada) of urea ranges from US$ 115 to 130 per ton. The price of murate of potash ranges from US$ 50 to 60, and the price of triple superphosphate is US$ 114 per ton.[74] Taking the mid-points of the price ranges and making a weighted average (using the proportions of urea, phosphatic, and potassic fertilizers presently used as weights), the f.o.b. price per ton of fertilizer works out to US$ 117 per ton. Adding the shipping cost (from U.S. gulf to East Indian Coast), the c.i.f. Chittagong price of fertilizer is estimated to be US$ 142 per metric ton. Adding the cost of distribution at the rate of 25 percent of c.i.f. cost at 1975-76 prices, the farm level cost per maund of fertilizers would be Tk 99.4 at the official exchange rate. The present sale price to farmers (on a weighted average basis) is Tk 56 per maund.

[74] International Bank for Reconstruction and Development, *Commodity Trade and Price Trend,* Report No. EC 166/77 (Washington, D.C., IBRD, 1977).

Price Elasticity of Rice Production: Two studies have addressed the question of how rice production responds to higher prices in Bangladesh. A relatively recent study by Cummings, using the time series data by district, estimated the short-run price elasticity of rice acreage to be 0.13. In a separate study Hussain obtained approximately the same estimate. The present study adjusts this estimate of price elasticity of production. As rice prices go up, producers have an incentive to farm more intensively, applying additional fertilizer to raise yields without increasing acreage. The amount by which yields will climb as a result of higher rice prices, the price elasticity of rice yields, is calculated by multiplying the demand elasticity for fertilizers with respect to rice price times the production elasticity of fertilizers.[75] The price elasticity of rice production thus calculated works out to be 0.18. Estimates of price elasticity of rice acreage in India and other Asian countries are not widely apart from this estimate.

Price Elasticity of Demand for Fertilizers: Very limited information is available on price elasticity for fertilizers. A study using time series data estimated short-run price elasticity of demand for fertilizers at −0.34.[76] Taking the estimates of marginal physical product (MPP) of fertilizer from a production function, and setting the marginal value product (MPP multiplied by price) equal to fertilizer price, one can derive a demand schedule for fertilizers. Using a production function analysis of rice, the elasticity of such a demand curve is estimated to be about −1.0. Because it is based on an assumption of perfect behavior, which is most likely to be violated in the risk-prone area of Bangladesh, this estimate may be taken as an upper limit to the elasticity estimate with the true estimate probably in between −0.34 to −1.0.[77] For the present analysis, the elasticity estimate is assumed to be −0.5 both for rice and jute.

Production Elasticity of Fertilizer: This is defined as the percentage change in production because of a percentage change in fertilizer application (dQ/dX)(X/Q). Based on production function analysis (2), these estimates are for rice, 0.104 and for jute, 0.06,where Q is the per acre production of rice and X is the per acre application of fertilizer.

Price Elasticity of Jute Production: In an earlier work by Rabbani,[78] the short-run elasticity estimate was 0.4. A recent study employing the same methodology as Rabbani's, but with recent data, estimated the short-run price elasticity of jute acreage at 0.21.[79] Working with the recent data, Rabbani and Hussain came out with an elasticity estimate of 0.22, arguing that structural change in the jute industry, mar-

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[75] If Q^* is the total production of rice and A is the total area under rice, then yield per acre (Q) is equal to Q^*. Therefore $Q^* = A \cdot Q$; $A = aP^{e_1}$; $Q = bX^{e_2}$; and $X = c(\frac{P}{Pf})^{e_3}$
where:

X = total amount of fertilizer used on rice
e_1 = acreage elasticity for the rice price
e_2 = yield elasticity for fertilizer
e_3 = demand elasticity of fertilizer
P = rice price
Pf = fertilizer price

By substituting and solving the equation it can be shown that
$Q^* = abc^{e_3} P^{(e_1 + e_2 e_3)} Pf^{-e_2 e_3}$

[76] Raisuddin Ahmed, *Foodgrain Production in Bangladesh: An Analysis of Growth, Its Sources and Related Policies* (Dacca: Bangladesh Agricultural Research Council, 1977).

[77] C. Peter Timmer, "The Demand for Fertilizers in Developing Countries," *Food Research Institute Studies* 13 (No. 3, 1974): 197-224.

[78] Rabbani, "Economic Determinants of Jute Production."

[79] Ahmed, *Foodgrain Production in Bangladesh.*

keting, and production has over time reduced the responsiveness of jute acreage to price changes. Taking the price elasticity of jute acreage at 0.22 and adjusting it for the effects of price changes on yield (as was done in the case of rice), the price elasticity of jute production is assumed to be 0.25 in the present analysis.

The price elasticity of export demand for Bangladesh raw jute is assumed to be highly elastic, so that a marginal change in jute production in Bangladesh causes little change in the price in the world market. Studies by Repetto[80] support the assumption quite closely. High supply elasticity of competing countries and overall competition from synthetic substitutes combine to make world prices unresponsive to marginal changes in jute production in Bangladesh. Moreover, even a modest change in this parameter value does not significantly change the results and the conclusions.

Estimation Formulas for Price Support and Fertilizer Subsidy

A simple power function with a constant elasticity is assumed for production, demand, and supply functions. The following notations are used:

B = Price elasticity of rice production (supply).
a = Production elasticity of fertilizer for rice.
d = Production elasticity of fertilizer for jute.
$-e$ = Price elasticity of fertilizer demand relating to rice as well as jute.
Bj = Price elasticity of jute production (supply).

Other symbols not mentioned here are defined in the text to Figures 5 and 6.

Price Support (PS)

(PS 1) — The government cost (difference between procurement cost and sales revenue including sales to rationing sector); which is represented by area ACLM or (Ps − Pd) (Qc − H).

(PS 2) — Increase in ration subsidy (negative revenue) from import substitution of rice; which is area ABRT or (Pd − Pw) (Qc − Qo) where Pd = OPd, Ps = OPs, Pw = OPw, Qo = OQo, Qc = OQc, and H = OH in Figure 5.

(PS 3) — The relation between Pd and Ps, which can be estimated as $Ps = Pd(1 + K)^{\frac{1}{b}}$, where K = (Qc − Qo)/Qo.

(PS 4) — The increase in rice producer income because of government support; this is area BCLM, or area BCPsPd − MLPsPd, which is calculated as

$$(1 - mr)\left(\int_{Pd}^{Ps} cP^{B}\,dP - H[Ps - Pd]\right),$$

where Ps and Pd are measured at retail levels and mr is the rate of marketing margin for rice assumed proportional to retail price, assuming a constant elasticity supply function, $Q = cP^{B}$, where c is a scaler including supply shifters.

(PS 5) — The decrease in producer income from jute is equal to

$$\left(\frac{1}{1 + Bj}\right)[PjQjo - PjQjs]),$$

where Pj is the farm level price of raw jute, Qjo is the production level of jute, and Qjs is the production of jute after price support of rice. Change in Oj is ob-

[80] Robert Repetto, "Optimal Export Taxes in the Short and Long Run, and an Application to Pakistan's Jute Export Policy," *The Quarterly Journal of Economics* 86 (August 1972): 815-825.

tained through the following equations:

$$(Qjo - Qjs)/Qjo = \left(\left[\frac{Pj}{Prs} - \frac{Pj}{Pro}\right]/\frac{Pj}{Pro}\right)Bj,$$

where Pro is equal to (1 − mr) Pd, and Prs is equal to (1 − mr) Ps. This measures the effect of rice price support on jute production.

(PS 6) — Net increase in producers' income; this is equal to (PS 4) − (PS 5).

(PS 7) — Net savings in foreign exchange is equal to the savings in foreign exchange from reduced import of rice minus the foreign exchange cost of net increase in import of fertilizer (increase in fertilizer for rice, decrease in fertilizer for jute), minus the value of the decreased export of jute. Savings from reduced imports of rice are equal to Pw(Qc − Qo). Net increase in Fertilizer use for rice (Xs) is equal to Xo $(Ps/Pd)^{-e}$ and for jute (Zs) is equal to

$$Zo\left(\frac{Pj}{Prs}/\frac{Pj}{Pro}\right)^{-e}$$

Net increase in fertilizer use ([Xs + Zs] − [Xo + Zo]) = Δ XZ Foreign exchange cost is equal to f • ΔXZ • Fw, where f is the imported fertilizer as a percent of total fertilizer demand (0.3), and Fw is the c.i.f. price of fertilizer. Reduction in jute export is equal to (Qjo − Qjs)Pjw, where Pjw is the f.o.b. price of raw jute.

(PS 8) — Reduced government revenue from lower jute export; which is equal to (Qjo − Qjs)t, where t is the export tax per unit of Oj.

Fertilizer Subsidy

(FS 1) — The fertilizer input required for a higher level of rice production (Qc), with other factors remaining constant; this is

$$Xs = Xo\ (Qc/Qo)^{\frac{1}{a}}.$$

(FS 2) — The price of fertilizer (Pfs) that would induce farmers to apply more fertilizers at the Xs level, or $Pfo(Xs/Xo)^{-\frac{1}{e}}$, which is equal to $Pfo(1 + k)^{-\frac{1}{ea}}$, where Pfo is the present farm level price of fertilizer, and K is (Qc − Qo)/Qo.

(FS 3) — Increased use of fertilizers on jute at price Pfs, which is $Zs = Zo(Pfo/Pfs)^{-e}$.

(FS 4) — Fertilizer subsidy cost, which is equal to (Xs + Zs) (Pfw − Pfs), where Pfw = Fw + unit distribution cost.

(FS 5) — Increase in ration subsidy (negative revenue) from import substitution of rice; this remains at the same level as in the price support program.

(FS 6) — Producer income originates in rice and jute sectors:
Rice Sector: Producer gain = (Pfo − Pfs) Xo + (1 − mr) Pd (Qc − Qo) − Pfs(Xs − Xo).
Jute Sector: Producer gain = (Pfo − Pfs) Zo + Pj(Qjs − Qjo) − Pfs(Zs − Zo), where $Qjs = Qjo(Zs/Zo)^{d}$.

(FS 7) — Net savings in foreign exchange are equal to the savings from reduced import of rice minus the foreign exchange cost of increased import of fertilizers for

rice and jute plus the value of increased jute export, i.e., net savings = Pw(Qc − Qo) − Fw ([Xs + Zs] − [Xo + Zo])f + Pjw(Qjs − Qjo), where f (the proportion of imported fertilizer to the total) is estimated to be 0.48.

(FS 8) — Government tax revenue from increased jute export is: (Qis − Qjo)t.

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