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SESSION 4: POLICY OBJECTIVE 1. PRICE STABILIZATION

Background paper (4a):

DOES PRICE STABILIZATION MATTER ANY MORE TO LOW-INCOME CONSUMERS IN BANGLADESH?

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DOES PRICE STABILIZATION MATTER ANY MORE TO LOW-INCOME CONSUMERS IN BANGLADESH?

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ACRONYMS

BBS	-	Bangladesh Bureau of Statistics
BRAC	-	Bangladesh Rural Advancement Committee
EP	-	Essential Priorities
FFW	-	Food for Work
FPMU	-	Food Planning and Monitoring Unit
GR	-	Gratuitous Relief
HES	-	Household Expenditure Survey
HKI	-	Helen Keller International
IFPRI	-	International Food Policy Research Institute
OMS	-	Open Market Sales
OP	-	Other Priorities
PFDS	-	Public Food Distribution System
RMP	-	Rural Maintenance Program
SR	-	Statutory Rationing
VGD	-	Vulnerable Group Development
TR	-	Test Relief
WGTFI	-	Working Group on Targeted Food Interventions

CONVERSIONS

Throughout this report, the Bangladesh taka is converted at the rate of 38.5 taka per United States dollar.

One crore equals ten million taka.

1. Summary

To relieve nutritional stress among Bangladesh's large vulnerable population, government has intervened in two principal ways, through: a) price subsidies on foodgrains; and b) targeted income transfers. This paper develops a multi-market model to compare the relative effectiveness of these two different tools in improving nutritional status of the poor.

The analysis indicates that price-induced nutritional stress has receded dramatically over the past two decades as a result of steady growth in foodgrain production. The emergence of a large Boro rice crop has dampened seasonal price spikes by about 19% during what was formerly a four-month lean season. As a result, caloric intake of vulnerable households has increased by 5% during those former lean season months. In addition, in the face of steady production increases, real foodgrain prices have fallen. They fell about 25% from 1972 to 1992, then a further 30% in the past year alone. The latest 30% fall in rice price has probably increased vulnerable group consumption by 7.4%, raising about 15 million people above the poverty line.

To further improve food consumption of the poor, projections modeled here suggest that income targeting will prove more effective than either general or targeted price subsidies.

2. Overview

OBJECTIVES

Half of all Bangladeshis cannot afford an adequate diet (Ahmed et. al., 1991). To relieve nutritional stress among this large vulnerable population, government has intervened in two principal ways, through: a) price subsidies on foodgrains; and b) targeted income transfers. This paper aims to compare the relative effectiveness of these two different tools in improving nutritional status of the poor.

PROGRAM OPTIONS

Price interventions in Bangladesh have included both general as well as targeted price subsidy programs (Table 1). Through its general open market sales (OMS) operations, government aims to depress seasonal price increases, thus relieving consumer stress in the lean season of September and October. Through its targeted ration channels - such as Palli Rationing, Statutory Rationing, and Essential Priorities channels - government offers rice and wheat for sale to selected groups at as much as 25% to 80% discount over market price.

Income transfers involve payment, in cash or in kind, through programs such as Food for Work (FFW), the "cash-for-work" Rural Maintenance Program (RMP), Vulnerable Group Development (VGD) and Test Relief (TR) programs. The "for work" programs screen recipients according to their willingness to work at low-paid manual labor. In contrast, the VGD program screens using administrative reviews to identify the most vulnerable households.

MOTIVATION

Extraordinary changes have occurred over the past several decades in the structure of foodgrain markets and in the structure of government food interventions. These changes affect both the need and impact of food policy interventions.

1. Changing pattern of price seasonality. The emergence of a large Boro rice crop has resulted in a dramatic natural dampening of seasonal price spreads (Figure 1). In the 1960's and early 1970's, production of a single principal foodgrain crop, Aman rice, dictated a classic single seasonal price peak, with a trough-to-peak price seasonal price rise of about 25%. But the advent of

a second rice crop, in the winter season, has has altered the pattern of price seasonality substantially. Instead of a single high price peak just before the Aus harvest in July, Bangladesh now witnesses two peaks - one before the Aman harvest in September and October and one before the Boro harvest in April. And the amplitude has been cut roughly in half. The former 25% seasonal price increase has fallen to 12 to 15%.[1]

Consumer stress in the lean season has been correspondingly reduced. A fringe benefit of the rapid structural change in agriculture, this changing price pattern suggests that the case for seasonal price stabilization has diminished dramatically over the past three decades.

Indeed, further reduction in an already low seasonal price spread may generate pernicious side-effects. In particular, it may further squeeze incentives for private foodgrain storage. This compounds concern that the case for seasonal price dampening may no longer be a relevant food policy objective.

2. Falling rice prices. Over the past two decades, real rice prices have fallen (Figure 2). After independence, they fell rapidly from the high levels witnessed during the liberation war and subsequent 1974 famine. Then, for nearly two decades, they drifted downward. From the post-famine low through 1992, real rice prices fell about 25%. The 1990's have brought a succession of good crop years and, for the second time since independence, a major decline in rice prices. In the past year alone, rice prices have fallen a further 30%.

Since poor households spend about 40% of their income on rice, this generally falling price has increased their real income as well as their consumption of rice. A 30% fall in rice price will increase the real income of net rice purchasers by 10 to 15%. If wage rates have held steady, this suggests that purchasing power and food consumption among the poor should have improved.

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[1]Nominal price increases may be 5-10% higher than this because of inflation. These seasonality spreads have been "detrended" to remove this inflation and estimate the portion of the price increase due purely to seasonality. Note also that these computations are based on monthly price data. Use of weekly prices will yield greater extremes than monthly averages and consequently seasonality spreads about 10% higher than the monthly figures.

3. Changing government practice. Over the past 20 years, government has gradually reduced the proportion of the Public Food Distribution System (PFDS) devoted to targeted ration channel price subsidies. Instead, they have increasingly favored more general, seasonal price stabilization through Open Market Sales (OMS) and targeted income transfers through the FFW, VGD and other related programs (Table 2). The steady growth of income transfer programs chronicles the rapid ascent of food aid and, presumably, charts the preferences of donors for income as opposed to price support. The shift from targeted ration channels to OMS suggests a growing government preference for general, rather than targeted, price subsidies. This move is driven largely by budgetary pressure. OMS sales impose lower budgetary cost, since they involve sale at market price, or close to it, while the ration channels involve high rate of subsidy. The high leakage documented in recent reviews of the ration channels has further motivated government disenchantment with targeted ration price subsidies (Ahmed, 1992; BRAC, 1991).

While cost concerns have probably driven evolution of government food programming, the resulting changes hold consequences for the level of nutritional benefits that ensue.

HYPOTHESES

In view of these historical shifts, this paper aims to test the following hypotheses.

Hypothesis 1: Changes in both the level and seasonality of foodgrain prices have reduced nutritional stress among low-income consumers, in general and especially during the lean season.

Hypothesis 2: Income transfers are more cost-effective than price subsidies in improving vulnerable group nutrition.

Hypothesis 3: If at all price susidies are to be introduced, they should focus on wheat rather than rice.

Figure 1 Index of Coarse Rice Price (Detrended)

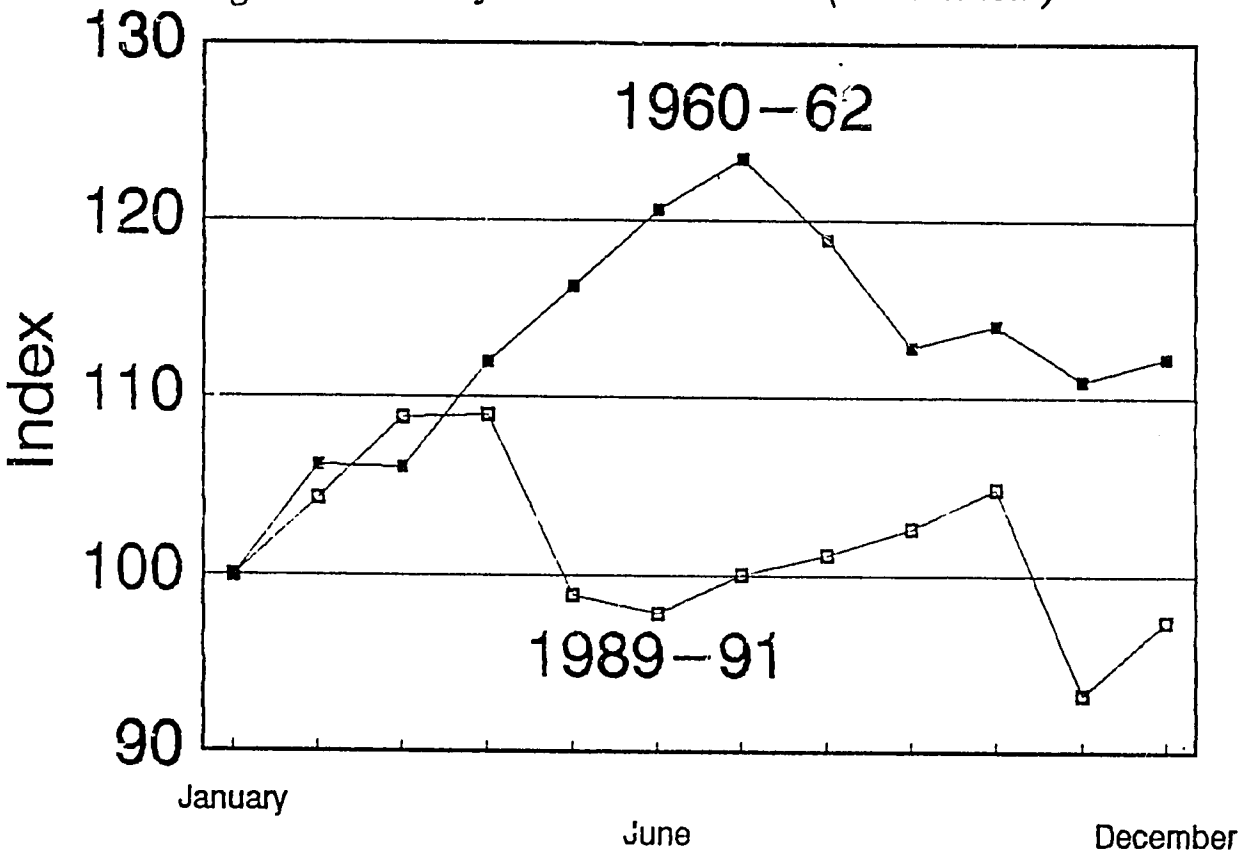
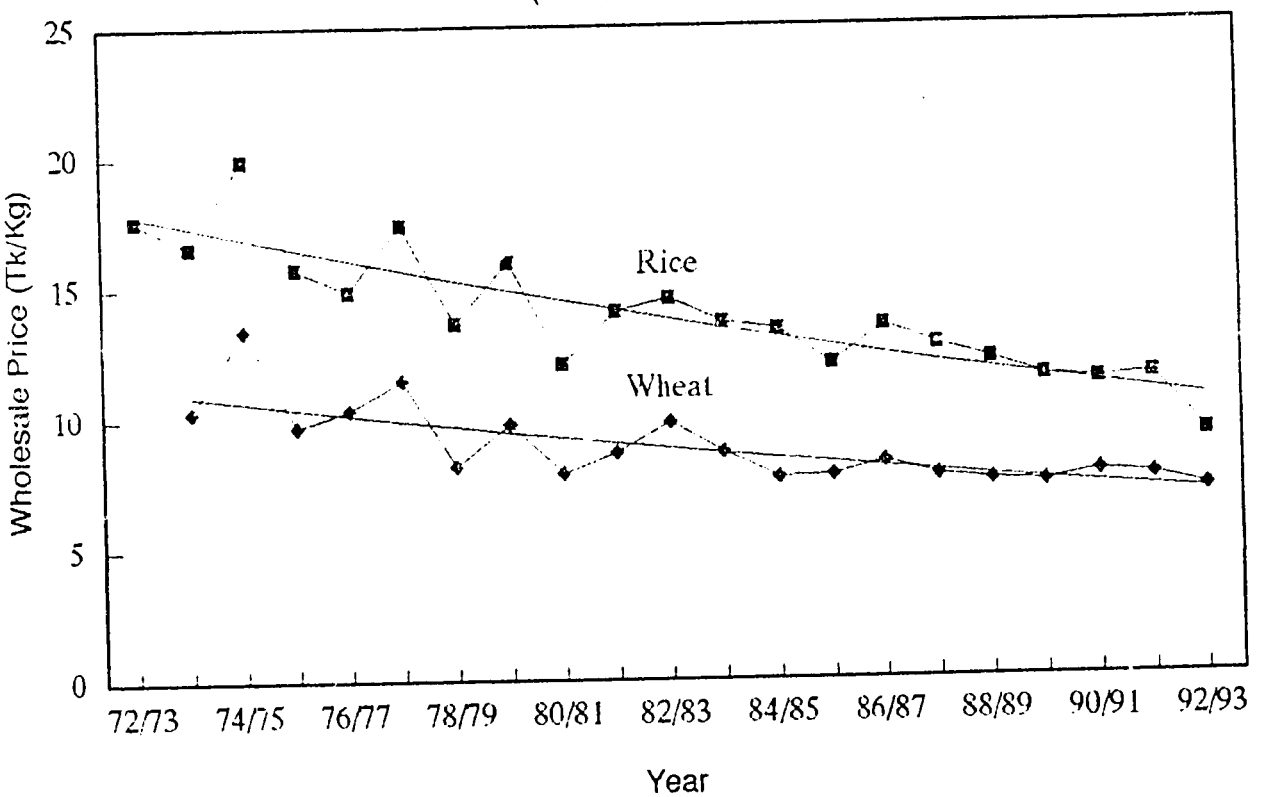


Figure 2– Trends in Real Foodgrain Prices

(1972/73–1992/93)



Note : Deflated by Implicit GDP Deflator. Base Year 1992/93=100

Source : Annex Table C.1.

Table 1 — A Classification of Food Interventions in Bangladesh

Intervention Commodity	Price Subsidies		Targeted Income Transfers
	a. General	b. Target group specific	
Rice	OMS	RP EP OP	
Wheat	OMS	SR EP OP	FFW VGD TR GR
Cash	-	-	RMP

EP = Essential Priority
FFW = Food for Work
GR = Gratuitous Relief
OMS = Open Market Sales
OP = Other Priorities
PR = Palli Rationing
RMP = Rural Maintenance Program
SR = Statutory Rationing
TR = Test Relief
VGD = Vulnerable Group Development

Table 2 — Evolution of the Structure of the PFDS.

Years	Price Interventions		Targeted Income Transfer	Other (Flour mills)	Annual Offtake (tons)
	Open Market Sales	Ration Channels			
1972/3-1974/5	0%	86%	7%	7%	2034
1975/6-1977/8	2%	73%	14%	11%	1658
1978/9-1980/1	3%	68%	20%	9%	1898
1981/2-1983/4	6%	62%	26%	6%	2022
1984/5-1986/7	9%	49%	37%	6%	2080
1987/88-1989/90	7%	43%	44%	7%	2537
1990/91-1991/93	8%	38%	41%	13%	1930

3. Analytical Methods

THE APPROACH

The following analysis models consumer responses to income and price changes. Although it is analytical rather than empirical, this study does rely on recent field studies which measure consumer reactions to changes in income and food prices. Indeed, the present effort aims to complement the growing volume of empirical field work on consumption and nutrition. Some of these field studies track the seasonality of food consumption and the consequent seasonality of nutritional status (HKI, 1993). Others attempt to measure the nutritional impact of specific programs such as FFW, VGD and Palli Rationing (Kumar, 1988; Ahmed, 1993).

Because modeling exercises allow the analyst to hold "all other factors" constant, they permit sensitivity analysis and causal attribution that sometimes becomes blurred in field studies. In addition, modeling allows extrapolation beyond existing programs to new programs that do not yet exist but that may hold promise. Using previously measured consumption responses to known stimuli - these may be income, prices, breastfeeding or any of a number of others - models can project probable results of programs that vary these causal stimuli. In this way, when married together with solid empirical evidence, modeling exercises such as this can extend and enrich the understanding emerging from the individual-level observations of these field studies.

Given the high cost and long lead time required for field analysis of invidivual programs, policy makers must find some way of rapidly assessing the likely results of new or modified programs. The model advanced in this paper represents a first small step in that direction.

CONSUMER RESPONSE PATTERNS

To model the impact of government price and income transfer programs, we must begin with measurements of how low-income consumers respond to price and income changes.

Income. In response to income transfers, households typically increase their spending on consumer goods. Consumption studies of low-income households in Bangladesh suggest that every 10% increase in cash income increases their rice consumption by 7% (see Appendix Table A.4). Yet in similar cases, wheat consumption declines by 2% in

all but high-income urban areas.[2]

Prices. Price subsidies increase foodgrain consumption by making foodgrains more attractive relative to other foods. These subsidies also increase the recipient household's real income, and in doing so tend to increase consumption of all goods, not just the good subsidized.

In Bangladesh, as elsewhere, price responses are notoriously difficult to measure with precision. So empirical estimates vary considerably from one study to another. A recent study by Goletti and Boroumand (1992), using 1989 Household Expenditure Survey (HES) data from the Bangladesh Bureau of Statistics (BBS), indicates that a 10% fall in the price of rice would increase rice consumption by 7%. But Ahmed's (1993) recent work among low-income rural households measures a corresponding rice consumption increase of only 3%.

Because of the wide variation in measured price responses, this paper compares program impacts under two scenarios: a) high price responsiveness; and b) low price responsiveness. Annex A provides a summary of these different parameters and results. The main text reports the results using low price responsiveness parameters since these yield the more plausible results.

MODELS

The models used in this analysis take previously measured consumer responses to estimate changes in consumption and nutrition that result when government intervention alters rice and wheat prices or incomes of target groups.

Small, targeted programs. A very simple single-equation model suffices in estimating the impact of small, targeted programs that affect only a carefully delineated vulnerable group. When these work well, government simply changes the income or price faced by the target households, without affecting general price levels elsewhere in the economy. The Small Model in Annex A

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[2]Thus, wheat is what economists call an "inferior" good. That is, when income increases people buy less wheat because they would rather consume other commodities, such as rice, which the higher income enables them to afford. Although this may be changing in urban areas and among high-income consumers, wheat does remain an inferior good over all, particularly in rural areas and among low-income households (see Goletti and Boroumand, 1992).

summarizes the analytical procedure applied in these instances.

Large, general interventions. In contrast, the modeling of large-scale income transfer programs or general price interventions, such as Open Market Sales (OMS), require greater complexity. Since OMS rice sales dampen the rice price for all consumers, they affect all income groups, not just the poor. Because rice accounts for over one-third of all consumer expenditure in Bangladesh, OMS interventions that dampen the rice price also spill over into nonrice markets. By raising real income, falling rice prices increase consumer spending on other goods. For close substitutes such as wheat, falling rice prices shift consumption into rice and out of wheat, causing a fall in wheat prices as well. In this way, falling rice prices, or large income transfer programs, affect the price of other foods and nonfoods as well.

Since rice dominates both production and consumption in the Bangladesh economy, a fall in rice prices generates ripples throughout the economy, changing prices and consumption in all sectors. To sort out these inter-connections among markets requires a multi-market model. Drawing inspiration from the work of Hammer and Braverman (1988), Annex A describes the Multi-Market Model used in this analysis.

BASELINE

All models must project from some baseline. In Bangladesh, roughly 50 million people cannot afford an adequate diet (Table 3). Given the difficulty of accurately measuring food intake and poverty, individual studies may generate varying estimates, though most fall within this order of magnitude (Ahmed et al, 1991; Rahman and Hossain, 1992). Seasonal variations complicate the empirical task as do well-known difficulties in measuring intake of gathered foods as well as other consumption that takes place away from the home.

To give a feel for the magnitudes involved, Table 3 summarizes the characteristics of poor households in Bangladesh. Using data from the Bangladesh Bureau of Statistics (BBS) 1988/89 Household Expenditure survey, it considers as poor housholds that consume less than the minimum calorie requirement of 2,122 Kilocalories per day. Given this delineation, the BBS figures suggest that the average poor household spends taka 3,550 ($90) annually per person, about 45% of it on foodgrains. Foodgrains likewise dominate caloric intake, with rice alone accounting for 74% and wheat an additional 12%. Even so,

the average poor household consumes only about 84% of minimum caloric requirements.

Income transfers or price reductions may increase food consumption from these low levels. To see how much, the two models described above project the following estimates.

Table 3 — Profile of Poor Households' Consumption

	Rural	Urban	Total Poor*
Population (millions)	47.1	5.7	52.8
Monthly Expenditure (taka/capita)**	280	390	292
Share spent on			
rice	41.0%	31.9%	40.0%
wheat	5.5%	3.3%	5.3%
other foods	31.1%	39.2%	32.0%
nonfoods	22.4%	25.6%	22.7%
total	100.0%	100.0%	100.0%
Caloric intake (calories per day)			
rice	1,329	1,329	1,329
wheat	219	175	214
other foods	229	357	242
total	1,777	1,861	1,786
Share of Calories			
rice	74.8%	71.4%	74.4%
wheat	12.3%	9.4%	12.0%
other foods	12.9%	19.2%	13.6%
total	100.0%	100.0%	100.0%

* Poor defined as households whose caloric intake falls below 2,122 K.calories per person per day.

** Conversion rate is 38.5 taka per U.S. dollar.

Sources: Bangladesh Bureau of Statistics (1991a, 1991b); Goletti and Boroumand (1992).

4. Results

IMPACT OF DAMPENED PRICE SEASONALITY

Production of a large winter rice crop has transformed July's seasonal price spike into a post-Boro-harvest price trough (Figure 1). Consequently, in the former lean season months of May through August, seasonal price movements now stand 16% to 25% below those prevailing 30 years ago. On average, this natural price dampening has reduced lean season prices by 19% during this four month period.

What is the impact on nutritional stress? Caloric intake has probably risen 5% during each those four months (Table 4). From the current base of 1,786 calories per capita, the new, Boro-induced seasonal price reduction allows low-income households to increase consumption from 84% to 89% of caloric requirements during these four months. Given increased labor demand during the Boro rice harvest, wage income has also increased during this period, further reducing the sting of a formerly serious lean season. Previously, the seasonal price rise alone would have compressed consumption down to 79% of requirements during these lean season months.

For government to have achieved a similar seasonal price dampening through Open Market Sales (OMS) would have required sales of an additional 1.6 to 1.9 million metric tons of rice each year during these months. Depending on cost assumptions, this would have cost the treasury about 462 to 558 crore taka ($120 to $145 million) per year (see Annex B). Thus, nutritional benefits and budgetary savings are two of the many benefits bestowed by the Green Revolution.

Seasonality of food consumption, though reduced, remains a problem for Bangladesh's hard-core poor. September and October now emerge as the most stressful season. Although prices are now highest in those months, just prior to the Aman rice harvest, a virtual absence of wage labor demand in these late monsoon months is probably the largest contributor to reduced consumption during this period.

IMPACT OF FALLING RICE PRICE

Real foodgrain prices have tended downward during the twenty years since independence (Figure 2, Annex Table C.1). Over and above the roughly 25% reduction in the prior twenty years, they have fallen a further 30% in the past 12 months alone.

Table 4 — Impact of Dampened Price Seasonality on Vulnerable Households' Consumption during the Former Lean Season Months of May through August

	Simple Model	Multi-Market Model
Monthly rice price reduction due to Boro harvest (May through August, 1990's vs. 1960's)	19.25%	
Resulting impact in monthly consumption of low-income households (percent change)		
rice	5.8%	27.9%
wheat	-18.3%	-22.5%
other foods	1.9%	-77.9%
total calories	2.4%	7.0%
Best guess change in total calories	4.7%	

Source: Calculated from Annex A, Tables A.6 and A.7.

As a result of the latest 30% fall in rice price consumption has probably increased sufficiently among low-income households to raise caloric intake on the order of 7.4% (Table 5). A rice price fall of this magnitude raises consumption of vulnerable households from roughly 84% to 92% of requirements, on average. Even the most impoverished have seen their consumption standard materially improved by the free fall in rice price. Under plausible assumptions, this price fall would raise about 15 million people above the poverty line. But given unequal income distribution, 35 million probably still remain underfed. While the current low rice price has likely made a considerable dent in undernutrition, it is not a cure-all for the tough problem of hard-core poverty.

A 30% fall in the rice price is equivalent to a real income transfer of 2,200 crore taka ($600 million) from landowners and surplus households to net consumers of rice.[3] Roughly half of this amount accrues to the urban poor and the functionally landless, an income transfer the same magnitude as annual food aid and relief allocations.

For the poor to maintain this nutritional gain will require stable wage rates and employment - as well as continued low rice prices. While wages appear to have remained strong during the gradual rice price slide of the past five years, they bear close monitoring in the future. Since the poor have only their labor to sell, food prices and wage rates determine their consumption. Together with foodgrain prices, those concerned with eradication of undernutrition must add wage rates to their list of key barometers.

INCOME VS. GENERAL PRICE SUBSIDIES

Government, through its large investments in agricultural research and recent agricultural policy reforms, has stimulated the steady advance of Boro rice cultivation and the consequent change in rice price behavior. Consumer benefits from the resulting dampened price seasonality and the falling real rice price represent indirect nutritional benefits of government's agricultural policy.

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[3]Farmers, of course, bear the cost of this income transfer. Since large and medium farmers account for two-thirds of marketed surplus, they, together with large absentee landownders bear the bulk of this transfer (Chowdhury, 1992). Small landowners, who market the remaining one-third, may face difficulty as a result of the transition to a regime of markedly lower foodgrain prices. Yet the very poorest members of society, the landless, are the prime beneficiaries.

Table 5 — Impact of the Recent 30% Fall in Rice Prices on Food Consumption of Vulnerable Households

	Simple Model	Multi-Market Model
Fall in rice price	30%	
Resulting percentage change in monthly consumption of low-income households		
rice	9.0%	43.5%
wheat	-28.5%	-35.0%
other foods	3.0%	-121.4%
total calories	3.7%	11.0%
Best guess change in total calories	7.4%	

Source: Calculated from Annex A, Tables A.5 and A.6.

But government has also contributed directly to improving food consumption, through income transfer programs and price subsidies (Table 6).

Nutritional impact of general rice price subsidy. To raise caloric intake of poor households to minimum nutritional standards would require an additional 8% increase above the current levels projected in Table 5. To achieve this through price subsidies would necessitate lowering the rice price a further 22% below current levels. With a tightly run open market operation, this would cost about 1,570 crore taka ($400 million) per year, about one-third of the cost of a nation-wide income safety net (Table 7).[4] To protect farmers from the dislocation of this substantial further fall in rice price would require expensive farm price support, bringing the total for rice price subsidy program to 5,228 crore taka ($1.36 billion) annually, about 15% higher than a pure income safety net.

Note also that income transfers are divisible, while general price subsidies are not. Because national foodgrain markets are well integrated, price interventions are lumpy, all-or-nothing affairs.

Wheat vs. rice. By subsidizing wheat prices, government can achieve the same nutritional impact at lower cost. Because wheat generally costs less than rice on world markets and because its domestic market is only one-tenth the size of rice, government can dampen wheat prices with much smaller quantities of a less expensive grain (Annex Table A.8). Consumer price subsidies on wheat would cost about 15% less than general interventions focused on the rice price (Table 7).

But because the domestic wheat market is only 2.5 million tons, compared to 20 million tons for rice, the desired consumpion increase will require a much larger depression of domestic wheat price - 83% compared to 22% for rice. A fall of this magnitude will probably require abandonment of domestic wheat production or complete government procurement at above the depressed market price. This farm price support would cost an additional 1,047 crore

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[4]These results report the most flattering of four rice price scenarios and the worst case for income transfers. These optimistic rice price projections depend on multi-market model results which report a rice price calorie response triple that obtained in the simple, non-interactive model. Under the simple model, the consumer price subsidies alone cost 7,750 crore taka ($2 billion) per year. See Annex Table A.8 for details.

Table 6 — Targeted Programs in Relation to Current Consumption of the Poor

	Expenditure (taka/month)	Quantity (kg/month) Rice	Wheat
Poor Households' Consumption			
per captia	292	10.9	1.8
per household	1,618	60.4	10.2
Targeted Programs			
Income transfer			
Rural Maintenance Program	730	-	-
Vulnerable Group Dev.	(263)	-	31.3
Food for Work	(601-739)	-	88
Ration price subsidies			
Pally Rationing	(53)	19.5	-
Program Allotment/Household Consumption			
Income transfer			
Rural Maintenance Program	45.1%	-	-
Vulnerable Group Dev.	16.3%	-	306%
Food for Work	37.1-45.7%	-	863%
Ration price subsidies			
Pally Rationing	3.2%	32.2%	-

Notes: Parentheses indicate income trasfer implicit in ration or ration subsidy. Taka conversion is at 38.5 taka per U.S. dollar.

Sources: Ahmed (1993), Mitra (1991), WGTFI (1993).

Table 7 — Cost Effectiveness of Large-Scale Income and Price Subsidy Schemes in Increasing Caloric Intake of Poor Households

	Income Transfer	Price Subsidy Rice	Price Subsidy Wheat
Requirement for increasing caloric intake of poor households by 8%			
	+16%	-21.6%	-82.5%
Program cost ($ millions)			
consumer subsidy	$1,173	$ 408	$352
farm subsidy	0	950	272
total ($ millions)*	$1,173	$1,358	$624
total (crore taka)*	4,516	5,228	2,402
Cost per poor person per month			
consumer subsidy	$1.85	$0.65	$0.54
farm subsidy	0	1.50	0.43
total ($)*	$1.85	$2.15	$0.97
total (taka)*	71	83	38
Potential cost due to smuggling	0	+	++

* Assumes zero smuggling.

Source: Annex Table A.8.

taka ($272 million) per year. A further disadvantage of such heavy wheat price subsidies is that government will squeeze all private traders from wheat markets, leaving government as the sole domestic trader of wheat. Finally, price subsidies of this magnitude would undoubtedly lead to large-scale smuggling to India, thus increasing subsidy costs potentially without limit.

Producer incentives. In general, consumer price subsidies depress farmer incentives, diminish domestic production, and increase import dependence. This is what Timmer and colleagues (1985) call the "fundamental dilemma of food policy." Low prices favor consumers but penalize producers.

If government is to retain its stated objective of increasing domestic foodgrain production, major open market sales aimed at depressing consumer prices would require complementary large-scale government procurement at above-market prices. In the absence of a realistic free-market price, government will face the problem of setting an administrative procurement price. Strong political pressures to support farmers will incline government to err on the side of farmer protection. Currently, this political pressure has resulted in an administratively determined rice procurement price 80% above market levels. Subsidies of this magnitude become very costly and completely squeeze private traders out of the foodgrain trade, since no trader will pay a comparable premium over market price. So consumer price stabilization, in the face of simultaneous pro-farm policy, requires complementary and expensive farm price support.

The expense of farm subsidies, when added to the costs of consumer price subsidies, alter the program rankings. Rice price subsidies, emerge as the most costly means of achieving national nutrition targets, while income transfers are second. General wheat price subsidies emerge as least expensive means of raising general calorie consumption of the poor (Table 7).

Overall. If government wishes to raise average caloric intake of all poor households nation-wide up to minimum nutritional requirements, income transfers represent the only feasible means of doing so. The cheapest general price subsidy, on wheat, would lead to limitless cross-border smuggling given the steep 83% discount in wheat prices.

Given a less ambitious consumption target, say increasing vulnerable household calories by 1% rather than 8%, wheat

price subsidies present potentially the lowest cost intervention. Similar economy-wide rice price subsidies offer the most expensive solution.

Intermediate in cost, income transfers allow scaling of support programs to any size, commensurate with budgetary resources. In addition, income support can be targeted regionally and in varying levels to different target groups.

Though potentially cheapest, a large wheat price subsidy program reveals several disadvantages:

- it produces a virtual government monopoly on domestic wheat marketing
- requires collateral farm price support
- exposes government to heavy pressure in setting an administratively determined support price
- lumpy and indivisible, it imposes a minimum, all-or-nothing price tag
- the potential for widespread smuggling would limit the feasible level and hence impact of a price subsidy.

INCOME VS. TARGETED PRICE SUBSIDIES

Small, targeted programs may potentially solve the lumpiness and smuggling problems of general, economy-wide price subsidies. To make price subsidies divisible, several approaches are possible. One common solution, Fair Price Shops, allows identified vulnerable groups to purchase foods at discount prices. If purchase quantities are unlimited, the impact on recipient households is described in Annex Figure C.3. A common modification of this approach, the Ration Shops, limit quantities that beneficiaries can lift each month at the subsidized price. To see how the analytics of targeted price subsidies change with limited ration quantities, see Annex Figure C.4. Like these targeted price subsidies, income transfer programs are also perfectly divisible and routinely implemented on less than universal scale.

Bangladesh has historically operated a number of ration shop schemes, including Modified Rationing, Palli Rationing, Statutory Rationing, Essential Priorities, Other Priorities and Large Employers ration channels. Targeted income schemes include Food for Work, Vulnerable Group Development, Rural Maintenance Program, Test Relief and Canal Digging Programs. Although Bangladesh has not instituted any unlimited quantity Fair Price Shop programs, the modeling approach adopted here permits assessment of the likely impact of such programs.

Projecting the likely impact of a variety of targeted programs, Table 8 suggests several key conclusions.

First, in most cases - particularly in the face of easy resale at market prices - targeted price subsidy programs are analytically equivalent to income transfers (Figures C.1-C.4).[5] Even though some programs allow purchase of commodities at subsidized price, some deliver commodities for free, and some deliver cash, they all increase real income of the recipient households. This comes through most clearly in the identical subsidy cost panel of Table 8. In general, the relevant question becomes, "Which channel can deliver income to poor households at lowest cost?"

In comparing targeted schemes, income transfer programs emerge as most cost effective in Bangladesh, primarily because their leakage is lowest. Recent reviews unanimously document heavy leakages in Bangladesh's monetized ration channels (Ahmed, 1992; BRAC 1991; Chowdhury et al, 1986; Chowdhury et al, 1988; Haggblade et al, 1993; WGTFI, 1993). These leakages - generally diversions by intermediaries for resale on the open market - frequently range between 70% and 90%. Income transfer programs work better than subsidized ration sales for several reasons: a) they are organized differently - recipients come together at one place on the same day to receive entitlements and thus enjoy powers of agglomeration; b) income delivery programs are better supervised, often by donors and NGOs as well as by government; and c) they do not depend on the good will of private traders to pass on subsidized commodities to the impoverished. Although intrinsically it is possible to build ration shops with less leakage, the program machinery currently available in Bangladesh distributes income far more effectively than price subsidies.

This differential performance, at least in part, explains the recent evolution of PFDS distribution away from the ration shop price subsidies (Table 2). The ration channel leakage has undoubtedly motivated government's decisions to diminish the number and size of targeted price subsidies delivered through ration shops. This

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[5]The only exception is when ration quantities exceed current household consumption <u>and</u> when heavey transaction costs prevent the households from reselling their ration on the free market. If households can resell the ration, as with many Food for Work schemes, then rations of any size merely represent income transfers (Annex C, Figures C.3 and C.4.b). But when households are forced to either use it or lose it, the large ration produces both an increase in real income and a change in relative price (Annex C, Figure C.3, point b and Figure C.4b point b3).

Table 8 — Cost-Effectiveness of Small, Targeted Income and Price Subsidy Programs

	Targeted Income Transfer	Price Subsidies: Unlimited Qty (Fair price shop)		Price Subsidies: Limited Qty* (Ration shop)	
		Rice	Wheat	Rice	Wheat
Calories impact (percent) of a 1% change in income or price					
	0.660	0.667	0.667	0.122	0.095
Calorie target ----> 8%					
Requirement for increasing low-income calories by target amount					
	12.1%	10.8%	10.8%	65.5%	84.3%
Subsidy cost of increasing calories to target level (taka/person/month)					
no leakage	35	35	35	35	35
20% leakage	44	44	44	44	44
70% leakage	118	118	118	118	118
90% leakage	354	354	354	354	354
Delivery cost					
per taka of income	0.19				
per kg of grain		2.1	2.1	2.1	2.1
Total subsidy plus delivery cost (taka/person/month)					
no leakage	42.1	92.2	108.4	45.8	45.8
20% leakage	52.6	101.0	117.4	54.6	54.6
70% leakage	140.4	174.8	191.0	128.4	128.4
90% leakage	421.2	410.7	426.9	364.3	364.3
Best guess total cost (taka/person/month)					
	52.6	174.8	191.0	128.4	128.4

* Assume 5 kg ration per person per month

disenchantment has probably contributed to the corresponding rapid growth of income transfer programs.

The analysis suggests a final conclusion, this one analytical. As Figures C.3 and C.4 indicate, some ambiguity arises in projecting the impact of targeted price subsidies. The size of rations received, level of transaction costs, kind of commodity transferred (cash vs. wheat vs. rice) and who receives it (men, women) all influence how much of an entitlement recipient households consume, how much they market, at what price, and how they spend the resulting increased real income. While this modeling exercise has made a beginning, we require the results of empirical analysis currently under way before proceeding further and more systematically.

Necessary further inputs include firmer estimate of price response parameters, estimates of consumption propensities out of cash vs. commodity transfers, gender differences in spending, and transactions costs of marketing different commodities, by category of recipient. Because women commonly spend more on food, and because they probably face the highest transaction costs in male-dominated retail markets, they may be most attractive as beneficiaries of targeted food programs. With additional empirical evidence, and a more refined model, this preliminary exercise can be extended and improved.

5. Implications

POLICY IMPLICATIONS

Price subsidies. Do consumer price subsidies matter any more to low-income households in Bangladesh? No.

The advent of a large Boro harvest has considerably dampened seasonal price fluctuations. Further reduction in already low seasonal price spreads will only reduce incentives for private stockholding. Seasonal price dampening is no longer an urgent food policy objective.

Given record low rice and wheat prices, the case for further downward pressure and artificially "cheap rice" is weak. Production successes have achieved cheap rice for consumers without recourse to costly consumer price subsidies. The success of these agricultural policies now requires renewed focus on helping farmers maintain profitability and begin the difficult transition to a more diversified agriculture.

If at all government wishes to consider consumer price subsidies, they should focus on wheat rather than on rice as a lower-cost means of assisting vulnerable households. This conclusion contrasts, of course, with government's long tradition of rice price subsidies, through Modified Rationing, Palli Rationing and Essential Priorities. Yet in the face of record low wheat prices, large and indivisible program costs, prospects for widespread smuggling, and the danger of further depressing farmer incentives, the time does not appear propitious for further foodgrain subsidies, even on wheat.

Income and wages. In spite of the steady and sometimes spectacular fall in real foodgrain prices, many poor households still face acute hunger. So there is still a strong case for intervention. Most of all, vulnerable households need employment at reasonable wages. Low foodgrain prices and employment at high wages are twin elements of the solution to poverty alleviation. Thus policy makers must focus major attention on labor markets, trends in employment and wage rates.

In the interim, to the extent that budget pressures allow targeted safety netting, government can most profitably focus on income transfers rather than price subsidies. In addition to divisibility and greater cost effectiveness, these programs have the virtue of supporting producer prices rather further than depressing them.

Open market sales. Does this mean that no price intervention is required at all? No, some government open market operation is still necessary. Although ration channels have proven expensive and ineffective, government does require a well-functioning open market operation to handle procurement and stock rotation.

While rice markets, appear generally well integrated and competitive, some remote backwaters may still exist (Goletti and Farid, 1993). Thus an OMS capability may be an important component of a government strategy for preventing undue seasonal or geographic price spreads in reomote areas. But in this case, the aim would be more appropriately termed "market integration" rather than seasonal price stabilization.

Trade policy. A final potentially necessary price intervention involves tariffs and international trade. As private trade grows, and given wide swings in international price, it may prove necessary to introduce periodic tariffs to moderate swings in international prices, if they become a new source of price instability in the future. Given the current wide gap between import and export parity prices, this tool will probably need to be invoked only sparingly.

IMPLICATIONS FOR RESEARCH

Wage rates. Only two prices matter to the poor - the price of food and the price of their labor. For the poor in Bangladesh spend 70% on their earnings on food. And to earn necessary funds, they have only their labor to sell. Falling foodgrain prices represent unambiguously good news for net foodgrain consumers, provided their income remains steady. While wage rates appear to have held steady over the past decade, the future is less certain (Chowdury, 1992, Osmani, 1990). In particular, the implication of the recent free-fall in rice prices is unclear. Thus, research on rural and urban unskilled labor markets merits high priority. Both level of employment and wage rates are crucial to continued improvements in welfare of the poor.

Coarse rice. The distinction between coarse and fine grades of rice has received scant attention in previous empirical work. Both for potential export and for consumption of vulnerable groups, disaggregation of consumption responses, price movements and marketings will prove important.

Nonfoodgrains. Perhaps the central conclusion of the Multi-Market Model has been that nonfoodgrains matter.

They account for one-third of consumer purchases. And given high expenditure elasticities on nonfoodgrains, spillover effects from foodgrain interventions to nonfoodgrains may be quantitatively very important, as are the consequences for nutrition. More disaggregation and a deeper understanding of the production and marketing structure of key nonfoodgrains will be crucial in anticipating the nutritional impact of alternative food interventions. Micronutrients and other non-calorie requirements depend heavily on consumption of nonfoodgrains. Hence a clear need to diversify research, like production, away from rice and wheat.

Future modeling. Modeling offers prospects for systematically evaluating program options for improving nutrition of the poor. In undertaking such an exercise, analysts will need to consider the following issues and options:

- price vs. income instruments
- cash vs. commodity transfers
- size of ration entitlement
- to whom it is delivered
- transaction costs
- non-economic determinants of consumption and nutrition.

This preliminary effort has attempted to formulate a simple model and apply it to the first issue - price vs. income subsidies. Given the uncertainties over some of the response parameters, its conclusions must considered tentative. And the model itself requires some embellishments, as discussed in Annex A. In the future, with firmer estimates of consumer responses, and further evidence on cash and in-kind responses, transactions costs, different responses by women and men, it will be possible to construct a more complete set of prospective program comparisons for policy makers.

THE PAYOFF

To date, Bangladesh's major food policy reforms have focused on cutting government costs. And they have done so very effectively. It is now time to consider ways of boosting the nutritional benefits of government food policy. By building on simple models such as this, it may be possible to help focus a second, equally enthusiastic round of reforms on improving the nutritional benefits of public food interventions for the poor.

ANNEX A.

MODELING CONSUMPTION RESPONSES

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2. Multi-Market Model
3. Results
4. Implications for Future Work

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A.2. Matrix Specification of Multi-Market Model
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1. Modeling Small Interventions

APPLICATIONS

To increase vulnerable household consumption, government food policy typically manipulates either the prices these households pay or their income. When such interventions are small, they do not affect prices paid by other households. Nor do they affect other prices in the economy. Ideally, a small-scale income transfer program will only increase income of the targeted households; if they are not numerous relative to the overall market, then they will not bid up the price of basic foods which they buy. Similarly, a well-targeted price subsidy will ideally allow only target households to purchase the subsidized commodity, perhaps rice, at a discounted price. If total ration quantities are small, they will not affect either the general rice price or prices of other commodities in the market. Similarly, if all prices in the economy are perfectly elastic, then interventions in one market will not spill over into another.

In these instances, simple cross-price elasticities of demand will suffice in estimating the effect of price and income changes on food consumption.

ASSUMPTIONS

The critical assumption in using this model is that government interventions generate no spillover effects from one market to another. Consider an intervention - such as a rice price subsidy - which leads to a large change in demand for wheat and other goods. This, in turn, will change relative prices and alter consumption of rice and other foods further in a second round of adjustments. In this case, a multi-market model is required to capture these interactions. The key assumption in using the simplified model is that there are no spillover and feedback effects from one market to another. Typically this is appropriate when interventions are well-targeted or small.

STRUCTURE

Caloric intake of low-income households (K_l) depends on the quantities of each commodity they consume (C_{il}) and the standard calorie conversion ratios (γ_i).

$$K_l = \gamma_r C_{rl} + \gamma_w C_{wl} + \gamma_f C_{fl} + \gamma_n C_{nl}$$

The subscript, i, represents each of four commodities:

rice (r), wheat (w), other foods (f) and nonfoods (n), as in equation 15 of Table A.1.

Consumption, in turn, depends on expenditure (E_l) and the prices (P_i) of commodities they consume.

$$C_{rl} = f(E_l, P_r, P_w, P_f, P_n)$$
$$C_{wl} = f(E_l, P_r, P_w, P_f, P_n)$$
$$C_{fl} = f(E_l, P_r, P_w, P_f, P_n)$$
$$C_{nl} = f(E_l, P_r, P_w, P_f, P_n)$$

These are the same as equations 5-8 in Table A.1.

To complete this simple model, note that in the face of constant marginal savings rate, changes in income result in equivalent proportional changes in expenditure (Table A.1, equation 13)

SOLUTION

In the general case, where government may influence any price or income, the calorie impact on low-income households is calculated as follows:

$$\sum^{K_l} X = \theta_{rl} \sum^{C_{rl}} X + \theta_{wl} \sum^{C_{wl}} X + \theta_{fl} \sum^{C_{fl}} X$$

The policy instruments (X) may include expenditure (E_l) or any commodity price (P_r, P_w, P_f, or P_n). The (θ_{il}) represent the calorie share of the ith commodity in low-income households' consumption, while $\sum^{Y}_{X}$ represent elasticities of Y with respect to X.

To estimate the impact of a rice price subsidy merely requires knowledge of the consumption response of each food commodity to changes in the rice price (the price elasticities) and the calorie share held by each commodity (θ_{il}).

Using the parameters in Table A.3, a 1% increase in rice price (P_r) will reduce caloric intake by .122%, calculated as follows:

$$\sum^{K_l} P_r = (.74)x(-.3) + (.12)x(.95) + (.14)x(-.10) = -.122$$

This result is displayed in the circled entry in Table A.5.

Although simple to calculate, these estimates may be misleading in the following cases.

2. Multi-market Model

USES

Since rice dominates both production and consumption in the Bangladesh economy, a fall in rice prices generates ripples throughout the economy, changing prices and consumption in all sectors. Likewise, large-scale income transfer programs will affect economy-wide prices of foodgrains, other foods and nonfoods as well. To sort out these inter-connections among markets requires a multi-market model.

For this paper, a multi-market model is necessary for modeling the impact of the following exogenous shocks:

- general (OMS) price interventions
- dampened price seasonality
- the recent 30% fall in rice prices
- large-scale income transfer programs such as FFW.

STRUCTURE

The model developed for these purposes includes two income groups, low-income (Y_l) and high-income (Y_h). It defines as low-income those who cannot afford to purchase minimum caloric requirements of 2,122 Kilocalories per person per day.

The model disaggregates commodities into four categories, symbolically represented as follows:

r - rice
w - wheat
f - other foods
n - nonfoods.

The model core includes supply-demand balances in each of these four commodity markets. These are listed in equations 1-4 of Table A.1.

Consumer demand is a function of expenditure and prices of all four commodities. Equations 5-8 model consumption of low-income households, while 9-12 do so for the nonpoor.

Because income transfers affect income and not necessarily expenditure, equations 13 and 14 explicitly model savings behavior and the connection between income and expenditure.

Finally, equations 15 and 16 translate from consumption to calories, via standard calorie conversions. Table A.1 lists all 16 equations in full.

EXOGENOUS VARIABLES

The model takes the production (Q_i) of all four commodities as exogenous and fixed in the short run. It also takes net exports and inventory changes (I_i) as constant for other foods and nonfoods. This completely inelastic response in the supply of other foods (S_f) and nonfoods (S_n) can be easily altered in future variants of the model.

Four remaining exogenous variables serve as the model's policy instruments:

Y_l - income of low-income households
Y_h - income of high-income households
P_r - rice price
P_w - wheat price.

In taking these as exogenous, the model presumes that government can manipulate incomes through transfer programs such as VGD, RMP and FFW. Exogenous foodgrain prices imply that government adjusts its own net imports and inventory levels to defend whatever price it wishes. In this way, I_r and I_w become endogenous.

Also exogenous to the model are the consumption parameters - all income and price elasticities - savings rates (v_i), and the calorie conversions (γ_{ij}).

ENDOGENOUS VARIABLES

In addition to net imports and stock changes of foodgrains (I_r and I_w), the prices of other foods (P_f) and nonfoods (P_n) also become endogenous. Likewise with all the left-hand-side variables in equations 5-16. Consumption of each commodity is endogenous and a function of expenditure and prices. This lies at the heart of the exercise, since policy manipulations affect income and prices. Then, through the consumption parameters, this generates changes in consumption and caloric intake. In all, this results in 16 endogenous variables, one per equation.

SOLUTION

The goal is to express each of the 16 endogenous variables as a function of the four exogenous policy instruments - Y_l, Y_h, P_r and P_w. To solve this model requires total differentiation of equations 1-16, then expression of all coefficients as shares and percentage changes. This results in a system of 16 equations of the following form:

$$A \times \hat{EN} = B \times \hat{EX},$$

where A is a 16x16 matrix of parameters, EN is a 1x16 vector of endogenous variables, B is a 4x4 matrix of parameters, EX is a 1x4 vector of exogenous variables, and ^ indicates percentage changes.

Solution simply requires the following matrix operations to solve for the endogenous variables as a function of the four exogenous instruments. That is,

$$\hat{EN} = A^{-1} \times B \times \hat{EX}$$

Table A.2 spells out these matrices and vectors in full. A simple Lotus spreadsheet suffices to solve the model.

PARAMETERS

This model uses consumption parameters estimated from two principal sources: a) BBS 1988/89 Household Expenditure survey, as estimated by Goletti and Boroumand (1993) and b) an IFPRI household consumption survey, as described by Ahmed (1993). Since neither has yet estimated a full demand system, it proved necessary to impose homogeniety and aggregation conditions afterward. In doing so, the model runs take rice and wheat elasticities as the most firm and imposes the necessary theoretical conditions by adjusting price and income parameters of the nonfoods. The resulting set of consistent parameters are displayed in Tables A.3 and A.4.

3. Results

Tables A.5 and A.6 present the full results for each model, one for the low price elasticities and one for the high. Table A.7 contrasts the key results directly.

SIMPLE VS. MULTI-MARKET MODEL

Results differ between the simple and multi-market models, suggesting that interactions across markets are significant. The biggest calorie differences emerge in response to declining rice prices. While the simple (low elasticity) model predicts a 0.12% calorie increase in response to a 1% fall in rice price, the multi-market model projects an increase of 0.37%, triple the impact of the simple model.

Interaction between rice and other foods accounts for this large difference. When the rice price falls, consumers real income increases and they spend more on other foods. Given a fixed supply, the price of other foods (P_f) rises significantly, 4.3% for each 1% fall in rice price. Most of the increased demand emanates from high-income households. In a second-round adjustment, the higher price of other foods then drives low-income households to shift more into lower-cost sources of calories, particularly rice. This feedback effect, lower consumption of other foods and higher increase in rice purchases compared to the simple model, leads to a larger calorie impact in the multi-market model.

HIGH VS. LOW PRICE ELASTICITY

In the high-elasticity case, the feedback from other foods is so pronounced that households increase wheat consumption rather than rice. This leads to the peculiar result that a fall in rice price reduces caloric intake. Stated in another way, introduction of a tax on rice would increase calorie consumption of the poor by driving them away from rice into cheaper sources of calories, such as wheat.

This high-elasticity result seems implausible. It exaggerates the response of other foods, whose large price increase is already overstated by the fixed-supply assumption of this particular model. Ongoing empirical work under way at IFPRI does, in some formulations, estimate low calorie response from a rice price fall. But it is never negative. Although theoretically possible, it seems unlikely the falling rice price would reduce calorie consumption of the poor.

The main paper reports the low price elasticity results for two reasons. First, the negative calorie response to rice price fall in the high elasticity scenario seems an exaggerated result driven by the assumed inelasticity of supply in other foods. The overstated price response in other foods is coupled with overstated consumer responses. The resulting negative calorie response is both implausible and unverified empirically. Second, the low-elasticity results paradoxically generate higher calorie response due to price interventions. This stacks the deck in favor of price interventions and against the maintained hypothesis that income transfers are preferred. The program recommendations in favor of income targeting, consequently, emerge more robust.

4. Implications for Future Work

The inter-market interactions appear to be quantitively important. Falling rice prices increase rice demand, dramatically shift demand for wheat and other foods and perceptibly increase prices in other foods. Thus, it appears important to pursue the multi-market models when exploring the impact of general foodgrain price subsidies.

In doing so, other foods merit closer scrutiny than they have enjoyed in the past. To date, work on food policy has focused heavily on foodgrains. Yet low-income households direct about one-third of total expenditure on other foods. The simple multi-market model advanced here shows that spillover effects from foodgrain interventions to nonfood markets may be quantitatively very important, as are the consequences for nutrition.

In future work it will be important to introduce a positive supply elasticity into other foods and nonfoods. The current inelasticity leads to large price swings and crowding out of low-income consumers by those with high incomes. This exaggerates price responses in other foods and therefore overstates the quantity responses that ensue.

Empirical questions also remain to be resolved. The wide spread between high and low estimates of income and price elasticities requires further empirical work.

Overall, it appears that interactions among markets matter. In evaluating general, economy-wide price interventions, this means that a multi-market model of some kind is necessary. These interactions merit further exploration as a low-cost means of anticipating the impact of alternative policy interventions for improving nutrition of vulnerable households.

Table A.1 — Multi-Market Model Specification

Supply - Demand Balances

1. $\bar{Q}_r + I_r = S_r = D_r = C_{rl} + C_{rh}$
2. $\bar{Q}_w + I_n = S_w = D_w = C_{wl} + C_{wh}$
3. $\bar{Q}_f + \bar{I}_f = \bar{S}_f = D_f = C_{fl} + C_{fh}$
4. $\bar{Q}_n + \bar{I}_n = \bar{S}_n = D_n = C_{nl} + C_{nh}$

Consumer Demand

5. $C_{rl} = f(E_l, \bar{P}_r, \bar{P}_w, P_f, P_n)$
6. $C_{wl} = f(E_l, \bar{P}_r, \bar{P}_w, P_f, P_n)$
7. $C_{fl} = f(E_l, \bar{P}_r, \bar{P}_w, P_f, P_n)$
8. $C_{nl} = f(E_l, \bar{P}_r, \bar{P}_w, P_f, P_n)$
9. $C_{rh} = f(E_h, \bar{P}_r, \bar{P}_w, P_f, P_n)$
10. $C_{wh} = f(E_h, \bar{P}_r, \bar{P}_w, P_f, P_n)$
11. $C_{fh} = f(E_h, \bar{P}_r, \bar{P}_w, P_f, P_n)$
12. $C_{nh} = f(E_h, \bar{P}_r, \bar{P}_w, P_f, P_n)$

Income to Expenditure

13. $E_l = \bar{Y}_l - V_l = \bar{Y}_l - v_l Y_l - \bar{v}_l = \bar{Y}_l (1-v_l) - \bar{v}_l$
14. $E_h = \bar{Y}_h - V_h = \bar{Y}_h - v_h Y_h - \bar{v}_l = \bar{Y}_h (1-v_h) - \bar{v}_h$

Consumption to Calories

15. $K_l = c_r C_{rl} + c_w C_{wl} + c_f C_{fl} + c_n C_{nl}$
16. $K_h = c_r C_{rh} + c_w C_{wh} + c_f C_{fh} + c_n C_{nh}$

Table A.1 – continued

Definitions

Q_i = domestic production of commodity
I_i = net exports plus inventory changes
S_i = total supply
D_i = consumption demand
C_{ij} = consumption of the ith commodity by the jth household
E_j = expenditure
Y_j = income
V_j = savings
v_j = marginal propensity to save
$\bar{v}_j$ = savings function intercept
K_j = caloric intake of jth income group
γ_i = calories per quantity of each commodity consumed

Table A.2 - Matrix Specification of Multi-Market Model

$$
\begin{array}{c|cccccccccccccccc}
 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 \\
 & \hat{I}_r & \hat{I}_w & \hat{P}_F & \hat{P}_W & \hat{C}_{RL} & \hat{C}_{WL} & \hat{C}_{FL} & \hat{C}_{WL} & \hat{C}_{RH} & \hat{C}_{WH} & \hat{C}_{FH} & \hat{C}_{WH} & \hat{E}_L & \hat{E}_H & \hat{K}_L & \hat{K}_H \\
\hline
1 & 1 & 0 & 0 & 0 & -\alpha_{RL} & 0 & 0 & 0 & -\alpha_{RH} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
2 & 0 & 1 & 0 & 0 & 0 & -\alpha_{WL} & 0 & 0 & 0 & -\alpha_{WH} & 0 & 0 & 0 & 0 & 0 & 0 \\
3 & 0 & 0 & 0 & 0 & 0 & 0 & -\alpha_{FL} & 0 & 0 & 0 & -\alpha_{FH} & 0 & 0 & 0 & 0 & 0 \\
4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\alpha_{WL} & 0 & 0 & 0 & -\alpha_{WH} & 0 & 0 & 0 & 0 \\
5 & 0 & 0 & -\varepsilon_{P_F}^{C_{RL}} & -\varepsilon_{P_W}^{C_{RL}} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_{E_L}^{C_{RL}} & 0 & 0 & 0 \\
6 & 0 & 0 & -\varepsilon_{P_F}^{C_{WL}} & -\varepsilon_{P_W}^{C_{WL}} & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon^{C_{WL}} & 0 & 0 & 0 \\
7 & 0 & 0 & -\varepsilon_{P_F}^{C_{FL}} & -\varepsilon_{P_W}^{C_{FL}} & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_{E_L}^{C_{FL}} & 0 & 0 & 0 \\
8 & 0 & 0 & -\varepsilon_{P_F}^{C_{WL}} & -\varepsilon_{P_W}^{C_{WL}} & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & -\varepsilon_{E_L}^{C_{WL}} & 0 & 0 & 0 \\
9 & 0 & 0 & -\varepsilon_{P_F}^{C_{RH}} & -\varepsilon_{P_W}^{C_{RH}} & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & -\varepsilon_{E_H}^{C_{RH}} & 0 & 0 \\
10 & 0 & 0 & -\varepsilon_{P_F}^{C_{WH}} & -\varepsilon_{P_W}^{C_{WH}} & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -\varepsilon_{E_H}^{C_{WH}} & 0 & 0 \\
11 & 0 & 0 & -\varepsilon_{P_F}^{C_{FH}} & \varepsilon_{P_W}^{C_{FH}} & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -\varepsilon_{E_H}^{C_{FH}} & 0 & 0 \\
12 & 0 & 0 & -\varepsilon_{P_F}^{C_{WH}} & -\varepsilon_{P_W}^{C_{WH}} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & -\varepsilon_{E_H}^{C_{WH}} & 0 & 0 \\
13 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
14 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
15 & 0 & 0 & 0 & 0 & -\theta_{RL} & -\theta_{WL} & -\theta_{FL} & -\theta_{WL} & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
16 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\theta_{RH} & -\theta_{WH} & -\theta_{FH} & -\theta_{WH} & 0 & 0 & 0 & 1
\end{array}
\times
\begin{bmatrix} dI_R/S_R \\ dI_W/S_W \\ \hat{P}_F \\ \hat{P}_W \\ \hat{C}_{RL} \\ \hat{C}_{WL} \\ \hat{C}_{FL} \\ \hat{C}_{WL} \\ \hat{C}_{RH} \\ \hat{C}_{WH} \\ \hat{C}_{FH} \\ \hat{C}_{WH} \\ \hat{E}_L \\ \hat{E}_H \\ \hat{K}_L \\ \hat{K}_H \end{bmatrix}
=
\begin{array}{c|cccc}
 & 1 & 2 & 3 & 4 \\
 & \hat{P}_R & \hat{P}_W & \hat{Y}_L & \hat{Y}_H \\
\hline
1 & 0 & 0 & 0 & 0 \\
2 & 0 & 0 & 0 & 0 \\
3 & 0 & 0 & 0 & 0 \\
4 & 0 & 0 & 0 & 0 \\
5 & \varepsilon_{P_F}^{C_{RL}} & \varepsilon_{P_W}^{C_{RL}} & 0 & 0 \\
6 & \varepsilon_{P_F}^{C_{WL}} & \varepsilon_{P_W}^{C_{WL}} & 0 & 0 \\
7 & \varepsilon_{P_F}^{C_{FL}} & \varepsilon_{P_W}^{C_{FL}} & 0 & 0 \\
8 & \varepsilon_{P_F}^{C_{WL}} & \varepsilon_{P_W}^{C_{WL}} & 0 & 0 \\
9 & \varepsilon_{P_F}^{C_{RH}} & \varepsilon_{P_W}^{C_{RH}} & 0 & 0 \\
10 & \varepsilon_{P_F}^{C_{WH}} & \varepsilon_{P_W}^{C_{WH}} & 0 & 0 \\
11 & \varepsilon_{P_F}^{C_{FH}} & \varepsilon_{P_W}^{C_{FH}} & 0 & 0 \\
12 & \varepsilon_{P_F}^{C_{WH}} & \varepsilon_{P_W}^{C_{WH}} & 0 & 0 \\
13 & 0 & 0 & \frac{1-V_L}{\delta_L} & 0 \\
14 & 0 & 0 & 0 & \frac{1-V_H}{\delta_H} \\
15 & 0 & 0 & 0 & 0 \\
16 & 0 & 0 & 0 & 0
\end{array}
\begin{bmatrix} \hat{P}_R \\ \hat{P}_W \\ \hat{Y}_L \\ \hat{Y}_H \end{bmatrix}
$$

$$
\begin{bmatrix} A \end{bmatrix} \times \begin{bmatrix} \hat{Endog.} \end{bmatrix} = \begin{bmatrix} B \end{bmatrix} \times \begin{bmatrix} \hat{Exog.} \end{bmatrix}
$$

Table A.3 -- Model Parameters

	Rice	Wheat	Other foods	Non-foods
Supply-Demand Structure				
Consumption share of total supply				
alpha(*,l) = C(ij)/Si	0.43	0.52	0.32	0.26
alpha(*,h)	0.57	0.48	0.68	0.74
Net import+inventory change (I) as a share of total supply				
i(i) = Ii/Si	0	0.5	0.1	0.3

Consumption Parameters (low elasticity)

Elasticity of demand for: --> with respect to:	Rice	Wheat	Other foods	Non-foods
For low-income households				
expenditure share, theta(l)	0.40	0.05	0.32	0.23
E(l)	0.70	-0.20	1.20	1.50
P(r)	-0.30	0.95	-0.10	-0.60
P(w)	0.00	-0.70	-0.05	0.00
P(f)	-0.05	-0.05	-1.00	-0.22
P(n)	-0.35	0.00	-0.05	-0.68
For high-income households				
expenditure share, theta(h)	0.29	0.02	0.37	0.32
E(h)	0.50	-0.10	1.00	1.52
P(r)	-0.20	0.55	-0.05	-0.44
P(w)	0.00	-0.40	-0.05	0.00
P(f)	-0.05	-0.05	-0.80	-0.19
P(n)	-0.25	0.00	-0.10	-0.90

Savings parameters

	Poor HH (l)	Non-Poor (h)
MPS = v(j)	0.02	0.17
E/Y = delta(j)	0.99	0.83

Calorie conversions per unit of food consumed

	Rice	Wheat	Other foods	Non-foods	
Unit of measure	taka	taka	taka	taka	
Units/kg	10.8	8.4	n.a.	n.a.	
Calories/kg	3650	3460	n.a.	0	
Calories/unit	338	412	56	0	
Calorie shares					
theta(*,l) = C(il)/K(l)	0.74	0.12	0.14	0	1.000
theta(*,h)	0.71	0.08	0.21	0	1.000

Table A.4 -- Consumption Parameters, Low and High Responses

Low Price Responsiveness

Elasticity of demand for: --> with respect to:	Rice	Wheat	Other foods	Non-foods
For low-income households				
expenditure share, theta(l)	0.40	0.05	0.32	0.23
E(l)	0.70	-0.20	1.20	1.50
P(r)	-0.30	0.95	-0.10	-0.60
P(w)	0.00	-0.70	-0.05	0.00
P(f)	-0.05	-0.05	-1.00	-0.22
P(n)	-0.35	0.00	-0.05	-0.68
For high-income households				
expenditure share, theta(h)	0.29	0.02	0.37	0.32
E(h)	0.50	-0.10	1.00	1.52
P(r)	-0.20	0.55	-0.05	-0.44
P(w)	0.00	-0.40	-0.05	0.00
P(f)	-0.05	-0.05	-0.80	-0.19
P(n)	-0.25	0.00	-0.10	-0.90

High Price Responsiveness

Elasticity of demand for: --> with respect to:	Rice	Wheat	Other foods	Non-foods
For low-income households				
expenditure share, theta(l)	0.40	0.05	0.32	0.23
E(l)	0.70	-0.20	1.20	1.50
P(r)	-0.60	2.50	-0.10	-0.60
P(w)	0.00	-1.50	-0.05	0.00
P(f)	-0.05	-0.05	-1.00	-0.22
P(n)	-0.05	-0.75	-0.05	-0.68
For high-income households				
expenditure share, theta(h)	0.29	0.02	0.37	0.32
E(h)	0.50	-0.10	1.00	1.52
P(r)	-0.45	1.40	-0.05	-0.44
P(w)	0.00	-0.50	-0.05	0.00
P(f)	-0.05	-0.05	-0.80	-0.19
P(n)	0.00	-0.75	-0.10	-0.90

Table A.5 -- Model Solutions under Low Price Responsiveness

Model (1) Solution: Small, Targeted Interventions

Percent Change in Endogenous Variables	Resulting from a 1% change in the following Exogenous variables				
	Yl	Pr	Pw	Pf	Pn
El	1.00	0.00	0.00	0.00	0.00
Crl	0.70	-0.30	0.00	-0.05	-0.35
Cwl	-0.20	0.95	-0.70	-0.05	0.00
Cfl	1.20	-0.10	-0.05	-1.00	-0.05
Cnl	1.50	-0.60	0.00	-0.22	-0.68
Kl	0.66	-0.12	-0.09	-0.18	-0.27

Model (2) Solution: Multi-Market Model

Percent Change in Endogenous Variables	Resulting from a 1% change in the following Exogenous variables			
	Pr	Pw	Yl	Yh
Ir	-0.449	0.098	0.063	0.022
Iw	1.299	-0.531	0.135	0.138
Pf	-4.342	2.136	-1.261	-0.687
Pn	3.902	-1.439	1.483	0.883
Crl	-1.449	0.397	0.244	-0.275
Cwl	1.167	-0.807	-0.137	0.034
Cfl	4.047	-2.114	2.386	0.643
Cnl	-2.277	0.498	0.781	-0.446
Crh	0.305	-0.128	-0.074	0.246
Cwh	1.442	-0.232	0.430	0.251
Cfh	-1.904	0.995	-1.123	-0.302
Cnh	0.800	-0.175	-0.274	0.157
El	0.000	0.000	1.000	0.000
Eh	0.000	0.000	0.000	1.000
Kl	-0.365	-0.099	0.498	-0.109
Kh	-0.068	0.099	-0.254	0.131

Table A.6 -- Model Solutions under High Price Responsiveness

Model (1) Solution: Small, Targeted Interventions

Percent Change in Endogenous Variables	Resulting from a 1% change in the following Exogenous variables				
	Yl	Pr	Pw	Pf	Pn
El	1.00	0.00	0.00	0.00	0.00
Crl	0.70	-0.60	0.00	-0.05	-0.05
Cwl	-0.20	2.50	-1.50	-0.05	-0.75
Cfl	1.20	-0.10	-0.05	-1.00	-0.05
Cnl	1.50	-0.60	0.00	-0.22	-0.68
Kl	0.66	-0.16	-0.19	-0.18	-0.13

Model (2) Solution: Multi-Market Model

Percent Change in Endogenous Variables	Resulting from a 1% change in the following Exogenous variables			
	Pr	Pw	Yl	Yh
Ir	-0.075	-0.230	0.254	0.136
Iw	0.792	-0.080	-0.382	-0.173
Pf	-4.342	2.136	-1.261	-0.687
Pn	3.902	-1.439	1.483	0.883
Crl	-0.578	-0.035	0.689	-0.010
Cwl	-0.209	-0.527	-1.249	-0.628
Cfl	4.047	-2.114	2.386	0.643
Cnl	-2.277	0.498	0.781	-0.446
Crh	0.305	-0.378	-0.074	0.246
Cwh	1.876	0.404	0.556	0.319
Cfh	-1.904	0.995	-1.123	-0.302
Cnh	0.800	-0.175	-0.274	0.157
El	0.000	0.000	1.000	0.000
Eh	0.000	0.000	0.000	1.000
Kl	0.114	-0.385	0.694	0.007
Kh	-0.033	-0.027	-0.244	0.137

Table A.7 – Simple vs. Multi-Market Model, Results for Low-Income Households

Model	Low Price Elasticity: Simple Model	Low Price Elasticity: Multi-Market Model	High Price Elasticity: Simple Model	High Price Elasticity: Multi-Market
	(resulting percentage change)			
Income increase of 1%				
Crl	.70	.24	.70	.69
Cwl	-.20	-.14	-.20	-1.25
Cfl	1.20	2.39	1.20	2.39
Cnl	1.50	.78	1.50	.78
Kl	.66	.50	.66	.69
Rice price falls by 1%				
Crl	.30	1.45	.60	.58
Cwl	-.95	-1.17	-2.50	.21
Cfl	.10	-4.05	.10	-4.05
Cnl	.60	2.28	.60	2.28
Kl	.12	.37	.16	-.11
Wheat price falls by 1%				
Crl	00	-.40	00	.04
Cwl	.70	.81	1.50	.53
Cfl	.05	2.11	.05	2.11
Cnl	00	-.50	00	-.50
Kl	.09	0.10	.19	.39

Table A.8 -- Cost-Effectiveness calculations for Large-Scale Income and Price Subsidy Schemes

	Income Transfer		Price Subsidy			
			Rice		Wheat	
	Simple Model	Multi-Market	Simple Model	Multi-Market	Simple Model	Multi-Model
Impact of a 1% change in income or price on caloric intake of the poor						
	0.66%	0.50%	0.12%	0.37%	0.09%	0.09%
Requirement for achieving an 8% increase in poor household caloric intake						
income	12.1%	16.0%				
price			-66.7%	-21.6%	-88.9%	-82.5%
grain supply (% change)			83.4%	27.0%	111.1%	103.1%
grain supply (MMT change)			16.7	5.4	2.8	2.6
Cost of consumer price subsidy ($ millions per year)						
low estimate*	$739	$977	$2013	$408	$397	$352
high estimate**	$887	$1173	$4169	$1350	$695	$645
Cost of consumer price subsidy ($ pr person per month)						
low estimate*	$1.17	$1.55	$3.18	$0.65	$0.63	$0.56
high estimate**	$1.40	$1.85	$6.59	$2.13	$1.10	$1.02
Cost of farm price support ($)						
domestic price ($/ton)			220	220	220	220
domestic production (million tons)			20	20	1.5	1.5
farm subsidy ($million/year)***			$2,935	$950	$293	$272

* Low estimate assumptions: Income transfer @ 1.25 times amount received by por household. OMS handling costs @ $54 per ton plus grain subsidy.

** High estimate assumptions: Income transfer @ 1.50 times amount received by por household. OMS handling costs @ $250 per ton for both rice and wheat.

*** Farm subsidy assumptions: Government buys all domestic production at current market price and sells at subsidized price. Remaining increase in supply is imported and sold at subsidized price.

ANNEX B.

MODELING SUPPLY INTERVENTIONS

THE GENERAL APPROACH

Through general price interventions, governments may attempt to depress peak season prices by unleashing government supply into the market. Or, to prop up farm prices after harvest, they may increase post-harvest procurement.

To dampen consumer prices, how much additional foodgrain supply must government inject into the market? Figure B.1 offers a graphical exposition of what is required to estimate the necessary government supply shift. By increasing market supply by X tons, government open market sales will lower market price from P_0 to P_1. Clearly, the resulting impact on price will depend on the responsiveness of consumers and suppliers to changes in price. The slopes of the demand and supply curves represent these responses graphically, while the elasticities of supply and demand estimate the responses algebraically.

In this simple schema, government action does not influence behavior of private traders; they respond solely to changes in price, whatever the source. If, however, private traders try to react, or second-guess government - as Chowdhury (1993) suggests they do - then empirical estimates of these feedbacks are required, together with a more disaggregated model to estimate the full impact of government intervention We leave this important embellishment to a later date. Note that if government intervenes according to well-known, predictable rules, there will be no second-guessing by traders and no shifts in behavior of private actors. In the current climate of rapidly changing government behavior and great uncertainty on the part of traders, it is very difficult to model trader responses. Past behavior may not serve as a good guide, since government behavior and market conditions are changing quite rapidly. Game theory rather than econometrics may be required to anticipate government and trader reactions. Given these uncertainties, for the moment, the following very simple model considers only government actions without any counter-action from private traders.

THE MODEL

This simple supply shifter model involves the following three equations:

1. $Q_s = Q_d$
2. $Q_d = D(P)$
3. $Q_s = S(P,X)$

where Q_s indicates quantity supplied, Q_d quantity demanded, P price, D demand, S supply and X an exogenous supply shock, in this case government open market sales.

This system of equations includes three endogenous variables: Q_d, Qs and P. Solution of the system involves totally differentiating all three as follows:

4. $\hat{Q}_s = \hat{Q}_d$

5. $\hat{Q}_d = E_d \times \hat{P}$

6. $\hat{Q}_s = E_s \times \hat{P} + \hat{X}$

In this notation, ^ represents percentage changes and Σ_d the price elasticity of demand and Σ_s the price elasticity of supply. The system defines each of the three endogenous variables - percentage changes in Qs, Qd and P - as a function of the demand and supply parameters (Σ_d, Σ_s) and X. When solved, equations 4-6 predict the percentage change in Q_d, Q_s and P resulting from a given change in X.

The resulting price equation is of most interest for present purposes. Substituting equation 4 into 5 and 5 into 6 collapses the system to a single equation 7.

7. $\hat{P} = \hat{X} / (\Sigma_d - \Sigma_s)$

To find the quantity shift required to generate a given percentage change in price merely requires solving equation 7 for X, as follows:

8. $\hat{X} = \hat{P} (\Sigma_d - \Sigma_s)$

RESULTS

Table B.1 summarizes the basic results under a range of demand and supply elasticities.

Figure B.1 — Impact of Open Market Sales on Foodgrain Prices

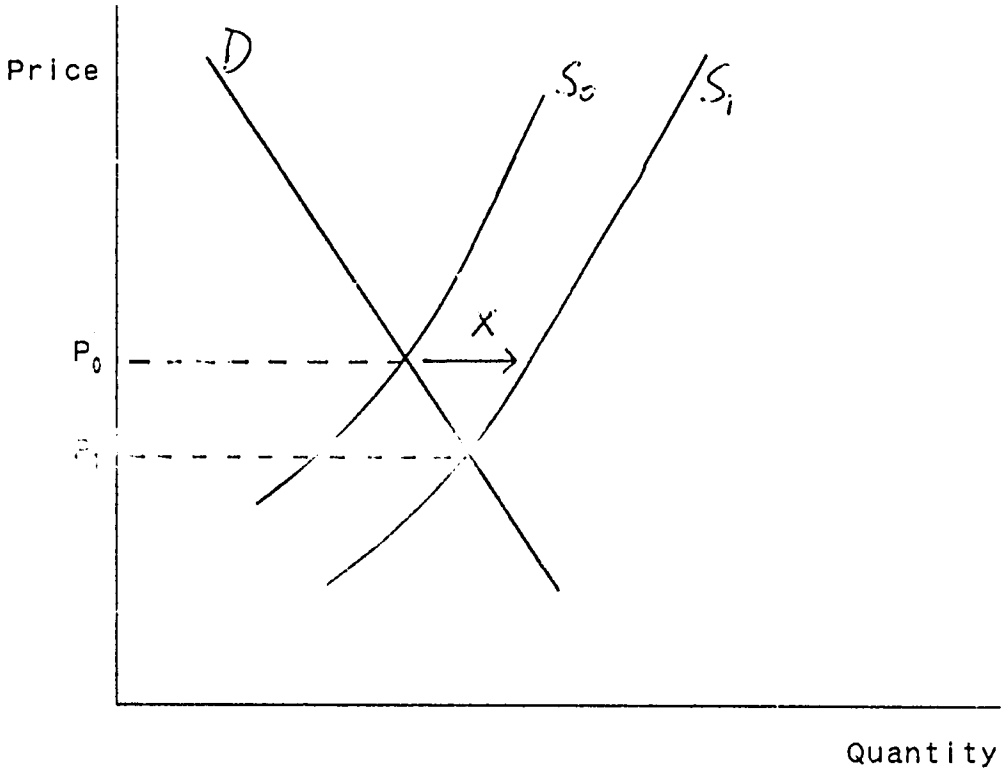


Table B.1 -- Open Market Sales Quantities Required to Dampen Foodgrain Prices by a Desired Amount

	Demand Responsiveness	
	Low	High
Desired price change (%)	-1	-1
Market responsiveness		
Demand elasticity	-0.25	-0.5
Supply elasticity	1	1
OMS sales quantity required (million tons)		
Rice		
required supply shift (%)	1.25	1.5
original monthly market supply (MMT)	1.67	1.67
OMS sales per month	0.021	0.025
OMS sales per year	0.250	0.300
cost - low ($ million/year)	US$13.74	US$16.49
cost - high ($ million/year)	US$62	US$75
Wheat		
required supply shift (%)	1.25	1.5
original monthly market supply (MMT)	0.21	0.21
OMS sales per month	0.003	0.003
OMS sales per year	0.032	0.038
cost - low ($ million/year)	US$1.73	US$2.08
cost - high ($ million/year)	US$7.88	US$9.45

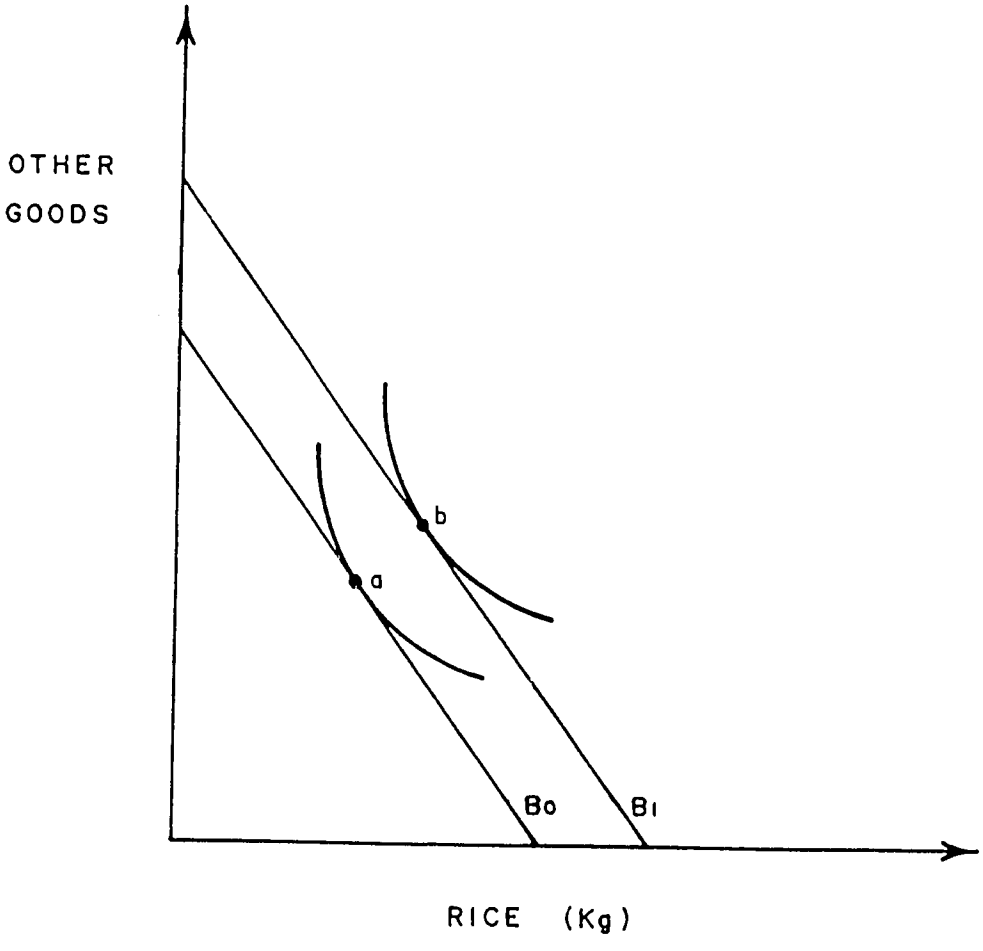
* Low cost includes $54 per ton handling cost plus price subsidy (Po-Ps)*OMS on grain sold through OMS.

** High cost includes handling cost plus 100% subsidy on each ton. Valued at $250 per ton for both wheat and rice.

ANNEX C.

SUPPLEMENTARY TABLES AND FIGURES

Figure C.1 — Income Transfer, Impact on Vulnerable Household Consumption



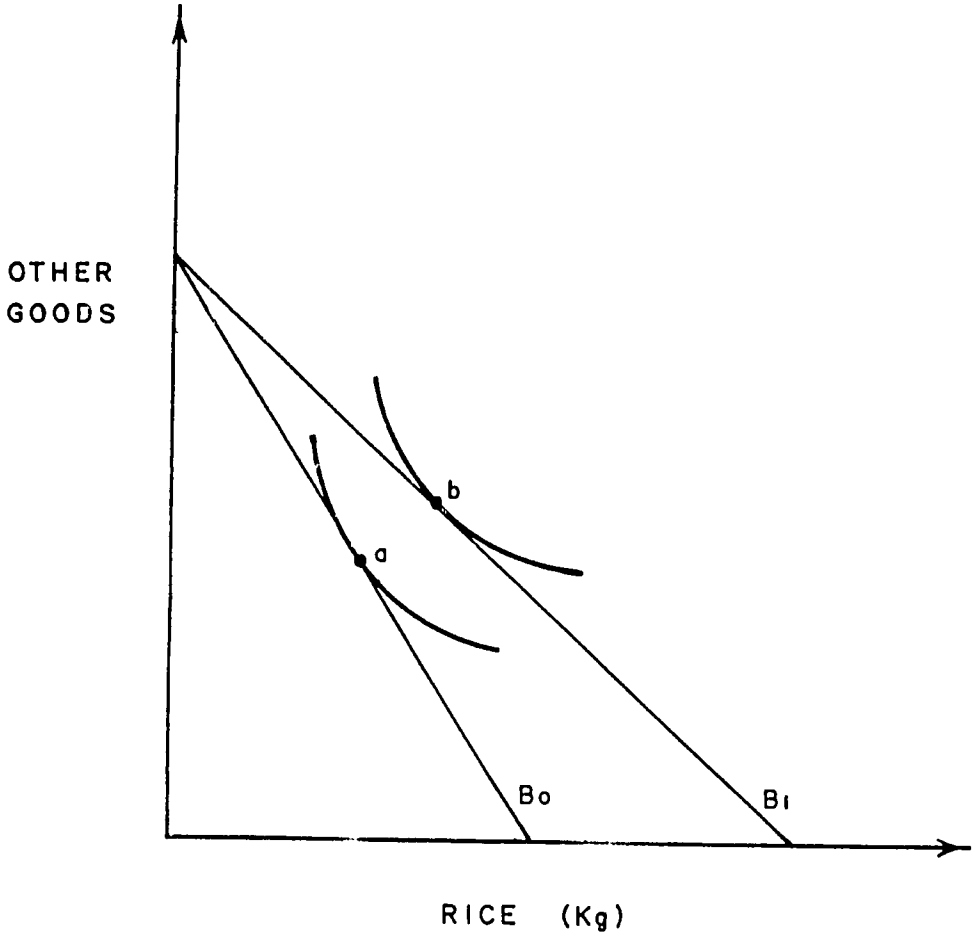
Bo = original budget

B1 = budget after income transfer

a = original consumption

b = consumption after income transfer

Figure C.2– General Price Subsidy, Impact on Vulnerable Household Consumption



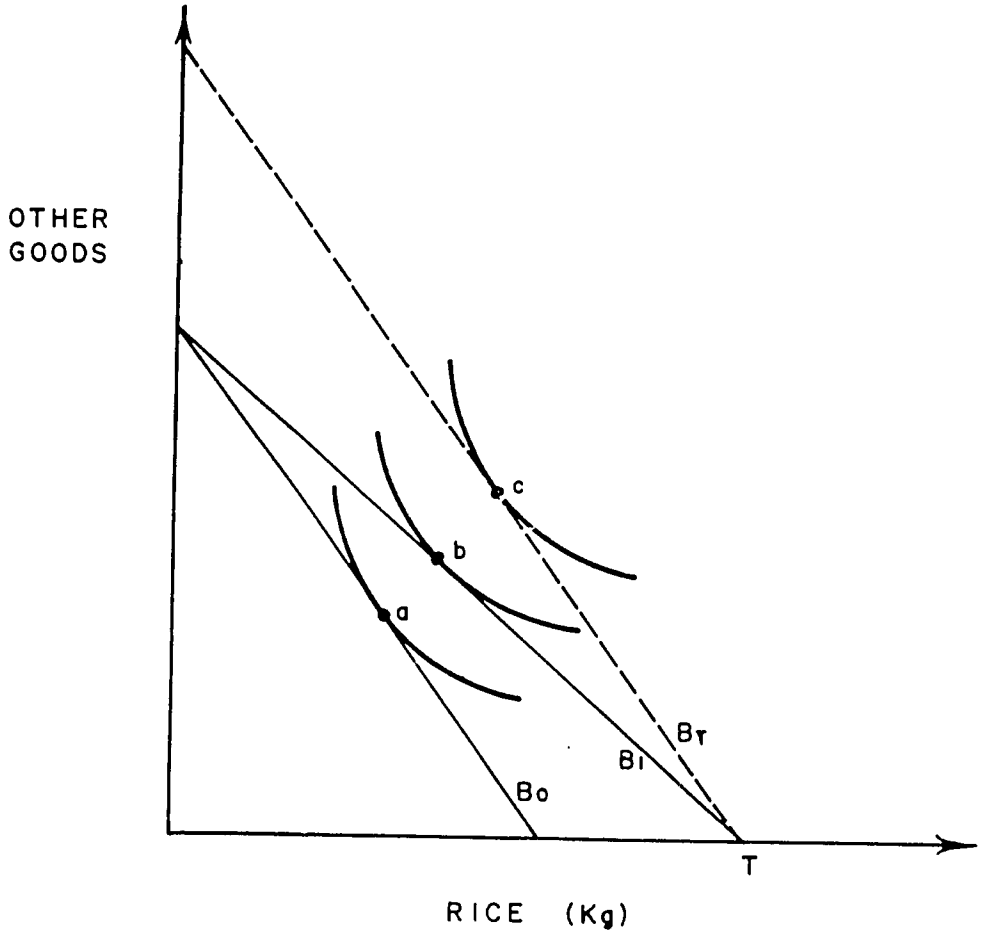
Bo = original budget

B1 = budget after income transfer

a = original consumption

b = consumption after income transfer

Figure C.3 – Fair Price Shops, Targeted Price Subsidy with Unlimited Ration Quantity and Easy Resale



B_O = original budget

B_I = budget after income transfer

B_T = budget after reselling subsidized grain at market price

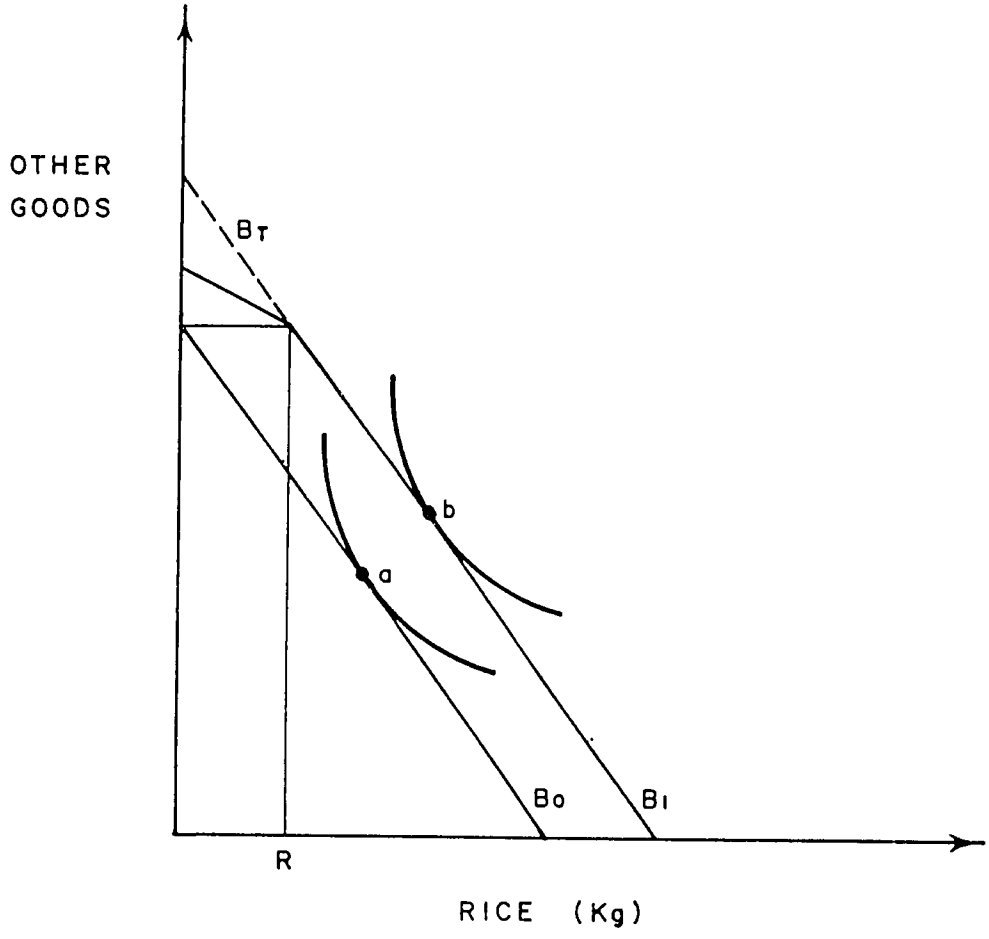
a = original consumption

b = consumption after income transfer

T = quantity of subsidized grain purchased with entire budget

Figure C.4 – Ration Shops, Targeted Price Subsidy, Ration Quantity Limits for Entitled Households

a. small ration



Bo = original budget

B1 = budget after income transfer

BT = budget after reselling subsidized grain at market price

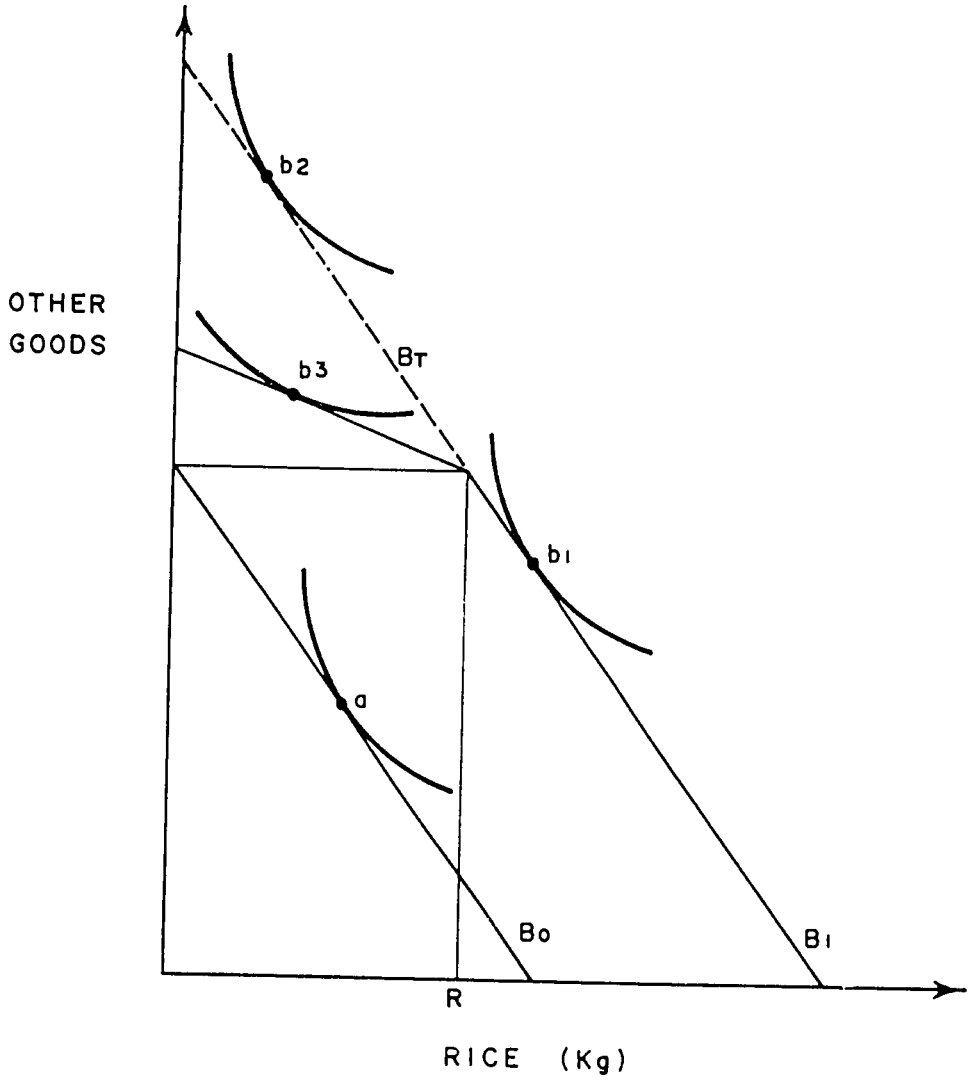
a = original consumption

b = consumption after income transfer

R = ration quantity

Figure C.4 – Ration Shops, Targeted Price Subsidy, Ration Quantity Limits for Entitled Households

b. large ration



Bo = original budget

B1 = budget after income transfer

BT = budget after reselling subsidized grain at market price

a = original consumption

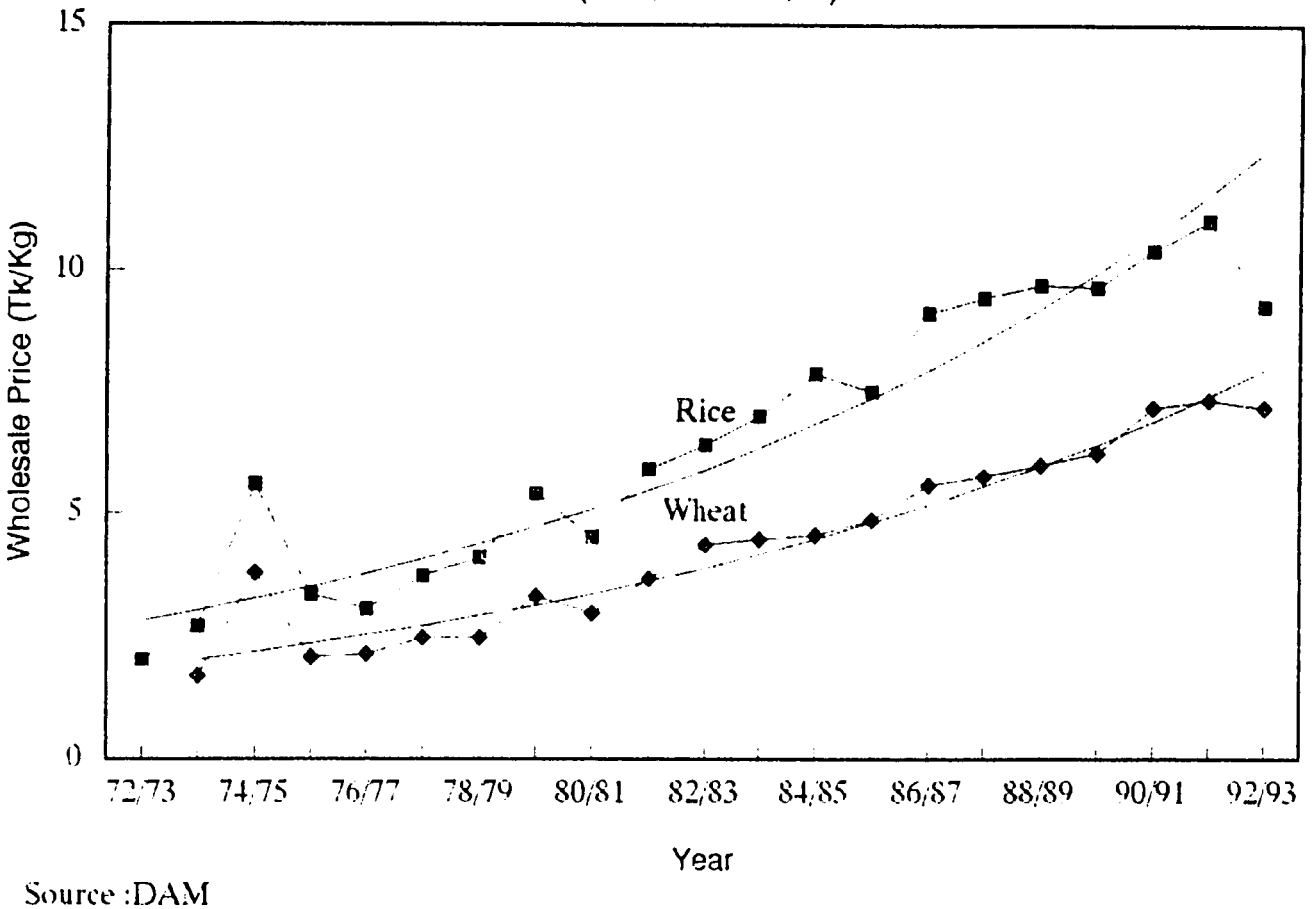
b1 = final consumption, if normal good

b2 = final consumption, if inferior good, easy resale & no transaction costs

b3 = final consumption, if inferior good and high transaction costs

Figure C.5 – Trends in Nominal Foodgrain Prices

(1972/73 – 1992/93)



Source :DAM

Table C.1— Wholesale Market Price of Coarse Rice and Wheat

Year	GDP Deflators (72/73=100)	GDP Deflators (92/93=100)	Rice (TK/Kg)	Wheat (TK/Kg)	Rice Trend	Wheat Trend	Real Rice (TK/Kg)	Real Wheat (TK/Kg)	Real Rice Trend	Real Wheat Trend
1972/73	100	11	2.02		2.80		17.60		17.81	
1973/74	142	16	2.69	1.67	3.01	2.02	16.55	10.29	17.36	10.91
1974/75	246	28	5.61	3.77	3.25	2.17	19.92	13.39	16.91	10.66
1975/76	185	21	3.34	2.06	3.50	2.33	15.74	9.70	16.48	10.42
1976/77	178	20	3.03	2.12	3.77	2.51	14.86	10.39	16.06	10.18
1977/78	186	21	3.71	2.45	4.06	2.69	17.41	11.50	15.65	9.94
1978/79	261	30	4.08	2.45	4.38	2.90	13.64	8.19	15.25	9.72
1979/80	295	34	5.40	3.31	4.71	3.11	15.97	9.80	14.86	9.49
1980/81	326	37	4.51	2.96	5.08	3.35	12.08	7.92	14.48	9.28
1981/82	367	42	5.90	3.66	5.47	3.60	14.05	8.70	14.12	9.06
1982/83	385	44	6.42	4.35	5.90	3.87	14.56	9.86	13.76	8.86
1983/84	449	51	7.01	4.46	6.35	4.16	13.63	8.68	13.40	8.65
1984/85	516	59	7.89	4.54	6.85	4.47	13.34	7.68	13.06	8.45
1985/86	544	62	7.51	4.85	7.38	4.80	12.05	7.79	12.73	8.26
1986/87	591	68	9.13	5.59	7.95	5.16	13.48	8.26	12.41	8.07
1987/88	647	74	9.43	5.75	8.56	5.55	12.73	7.75	12.09	7.89
1988/89	697	80	9.71	6.00	9.23	5.97	12.16	7.52	11.78	7.71
1989/90	732	84	9.65	6.25	9.94	6.41	11.51	7.45	11.48	7.53
1990/91	801	92	10.40	7.17	10.71	6.89	11.33	7.82	11.19	7.36
1991/92	836	96	11.02	7.34	11.54	7.41	11.51	7.67	10.90	7.19
1992/93	873	100	9.26	7.18	12.44	7.97	9.26	7.18	10.62	7.02

Note : GDP Deflator of 1992/93 is Estimated on the basis of last Two years.
Source : DAM & BBS

REFERENCES

Ahmed, Akhter U. 1993. "Food Consumption and Nutritional Effects of Targeted Food Interventions in Bangladesh." Dhaka: IFPRI.

Ahmed, Ahkter U. 1992. "Operational Performance of the Rural Rationing Program in Bangladesh." Working Paper No. 5, Bangladesh Food Policy Project. Washington, DC: IFPRI.

Ahmed, Akhter U., Khan, Haider A. and Sampath, Rajan K. 1991. "Poverty in Bangladesh: Measurement, Decomposition and Intertemporal Comparison," Journal of Development Studies, 27:4 (July): 48-63.

Bangladesh Bureau of Statistics (BBS). 1991. "Report on the Household Expenditure Survey, 1988-89." Dhaka: BBS.

Bangladesh Bureau of Statistics (BBS). 1991. "Population Census of 1991." Dhaka: BBS.

Bangladesh Rural Advancement Committee (BRAC). 1991. "Grain for thePor: A Look at Pally Rationing System in Bangladesh." Dhaka: BRAC.

Chowdhury, Nuimuddin. 1992. "A Reassessment of Bangladesh's Poverty Record, 1974-1984." The Bangladesh Development Studies 20:4 (December), pp 1-24.

Chowdhury, Nuimuddin. 1993. "Interactions between Private Rice Stocks and Public Stock Policy in Bangladesh: Evidence for a Crowding Out." Dhaka: IFPRI.

Chowdhury, N., Shahabuddin, Q., and Chosdhury, O.H. 1986. "The Existing System of Public Foodgrain Disibution in Bangladesh and a Proposal for Restructuring." a report prepared for the Ministry of Food. Dhaka: Beacon and Associates.

Chowdhury, N., Rushdie, A.A., and Bhuiyan, K. 1988. "Modified Rationing in Bangladesh: An Exercise in Reform to Increase its Effectiveness." a report prepared for USAID. Dhaka: Beacon and Associates.

Goletti, Francesco and Boroumand, Mehrdad. 1992. "Preliminary Estimation of Food Demand Parameters from the Bangladesh Household Expenditure Survey 1988/89."

Goletti, Francesco and Farid, Naser. 1993. "Structural Determinants of Market Integration: The Case of Rice Markets in Bangladesh." Washington, DC: IFPRI.

Haggblade, Steven, Rahman, Syed Ataur, and Rashid, Shahidur. 1993. "Statutory Rationing: Performance and Prospects." Dhaka: IFPRI.

Hammer, Jeffrey and Braverman, Avishay. 1988. "Computer Models for Agricultural Policy Analysis." Finance and Development (June).

Helen Keller International (HKI). 1993. "Seasonality of Nutritional Stress in Bangladesh." Dhaka: HKI.

Kumar, Shubh. 1988. "Rural Infrastructure in Bangladesh: Effects on Food Consumption and Nutrition of the Population." Washington, DC: IFPRI.

Mitra and Associates. 1991. "Integrated Food for Work Project: The Labor Survey of 1991." Dhaka: Mitra and Associates.

Osmani, S.R. 1990. "Structural Change and Poverty in Bangladesh: The Case of a False Turning Point." The Bangladesh Development Studies. (September).

Rahman, Hossain Zillur and Hossain, Mahabub. 1992. "Rethinking Rural Poverty." Dhaka: BIDS.

Timmer, C. Peter, Falcon, Walter P., and Pearson, Scott R. 1983. Food Policy Analysis. Baltimore: Johns Hopkins.

Working Group on Targeted Food Interventions. 1993. "Options for Targeting Food Interventions in Bangladesh, Final Draft." Dhaka: IFPRI.