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A SLUGGISH DEMAND COULD BE AS POTENT AS TECHNOLOGICAL PROGRESS IN CREATING SURPLUS IN STAPLE PRODUCTION: THE CASE OF BANGLADESH

by

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ABSTRACT

During the decade from 1982/83 through 1992/93, Bangladesh was able to increase production of rice, its staple food, at a rate modestly higher than the growth in population. However, the growth in per capita supply remained stagnant, because of the substitution of imports with domestic production. On the other hand, per capita income grew about 2 percent per annum. Nevertheless, the real price of rice declined about 2.7 percent annually. This decline in the rice price, on the face of a stagnant supply and increasing incomes, aroused suspicion whether income distribution has twisted against the poor who have a higher marginal propensity to consume rice compared to the rich. Three factors are identified that contributed to the decline in the rice price while per capita income increased: a) urbanization, b) diversification of diet, and c) income distribution. The analysis shows that, of a total demand depressing effect of 15.6 percent, urbanization accounts for 4 percentage points, cross-price effects for 7 percentage points, and worsening income distribution accounts, residually, for 4.6 percentage points. These findings are based on plausible values of demand and supply parameters which warrant fresh evaluation in the context of rapid structural change in the economy of Bangladesh.

INTRODUCTION

During the last decade Bangladesh has made a remarkable progress in achieving self-sufficiency in the production of rice, the main staple for the people of the country.[1] Many past governments have attempted to achieve this goal through successive five-year plans. But the success has never been at hand except in the early 1990s. Effective application of the seed-fertilizer technology is one of the cogent factors for this recent success (Ahmed 1994).

Self-sufficiency has conveniently been defined as the level of rice production that eliminates import. For planning purposes, the production target has been set by estimating the requirement at the rate of 16 ounces of grains per capita per day. However crude this method may appear to be, it has provided a single-minded approach to focus on the supply sides of self-sufficiency. However, with the success of the self-sufficiency drive, issues on the demand for rice are emerging in various colors. For one thing, some factors on the demand side, e.g. the declining rate of population growth, urbanization, and substitution, have partly contributed to the success of rice self-sufficiency. Rice production increased in Bangladesh at a rate (2.6 percent) slightly higher than population growth (2.2 percent) during the period 1982/83-1992/93. Total supply of rice increased even slower than production because of elimination of imports with the growth in production.

The apparent paradox of a falling rice price and rising per capita income within the context of an almost stagnant supply of rice in per capita terms has been the subject matter of an interesting intellectual debate in Bangladesh (Osmani 1990; Chowdhury 1992; Osmani 1993; Chowdhury 1993). Recently, the debate has taken a popular tune through newspaper articles (Hossain 1994). It has been inferred that the paradox implies a worsening income distribution in Bangladesh. A further extension of the inference could mean that, perhaps, the level of poverty has also deteriorated during the wake of rice self-sufficiency. Although some improvement in the level of poverty is possible even with a certain degree of worsening in income distribution, this is not the thrust of the inquiry here.

The purpose of this paper is to reexamine the paradox in order to see whether prices of rice and its demand and supply are all internally consistent in terms of the theoretical logic of comparative static and what implication it may bear for income distribution. An inference on the trend of income distribution would be made if such an inference is warranted after consideration of multiple factors that impinge on the demand for rice and rice prices. It is shown that a sluggish growth in demand for rice was as powerful as the growth in production in a marginal surplus of rice production in Bangladesh.

THE COMPARATIVE STATIC FRAMEWORK FOR RICE MARKET

In order to pursue the issue of causality in the falling rice prices, a beginning can be made with a conceptual framework embedded in the comparative static exposition of rice market. One can stipulate the demand and supply functions of rice as follows:

$$QS_{it} = f(P_{it}, T_t) \quad \textbf{(1)}$$

$$QD_{it} = f(P_{it}, P_{jt}, Z_t, Y_t) \quad \textbf{(2)}$$

$$QS_{it} = QD_{it} \quad \textbf{(3)}$$

QS_{it} = supply of rice in year t, t_1 = initial year, t_2 = final year;
QD_{it} = demand for rice in year t;
P_{it} = price of rice in year t;
T_t = state of technology in rice production in year t;
P_{jt} = index of prices of consumers' goods other than rice in year t;
Z_t = demand shift due to change in urbanization; and
Y_t = income level of consumers in year t.

The response of supply and demand to changes in the right-hand side variables is specified as follows:

$$\frac{\delta QS_i}{\delta P_i}\frac{P}{Q_s} \quad \alpha_1 \geq 0 \quad \textbf{(4)}$$

$$\frac{\delta QS_i}{\delta T}\frac{T}{Q_s} \quad \alpha_2 \geq 0 \quad \textbf{(5)}$$

$$\frac{\delta QD_i}{\delta P_i}\frac{P_i}{QD_i} \quad e_1 \leq 0 \quad \textbf{(6)}$$

$$\frac{\delta QD_i}{\delta P_j}\frac{P_j}{QD_i} \quad e_2 \leq 0 \qquad \textbf{(7)}$$

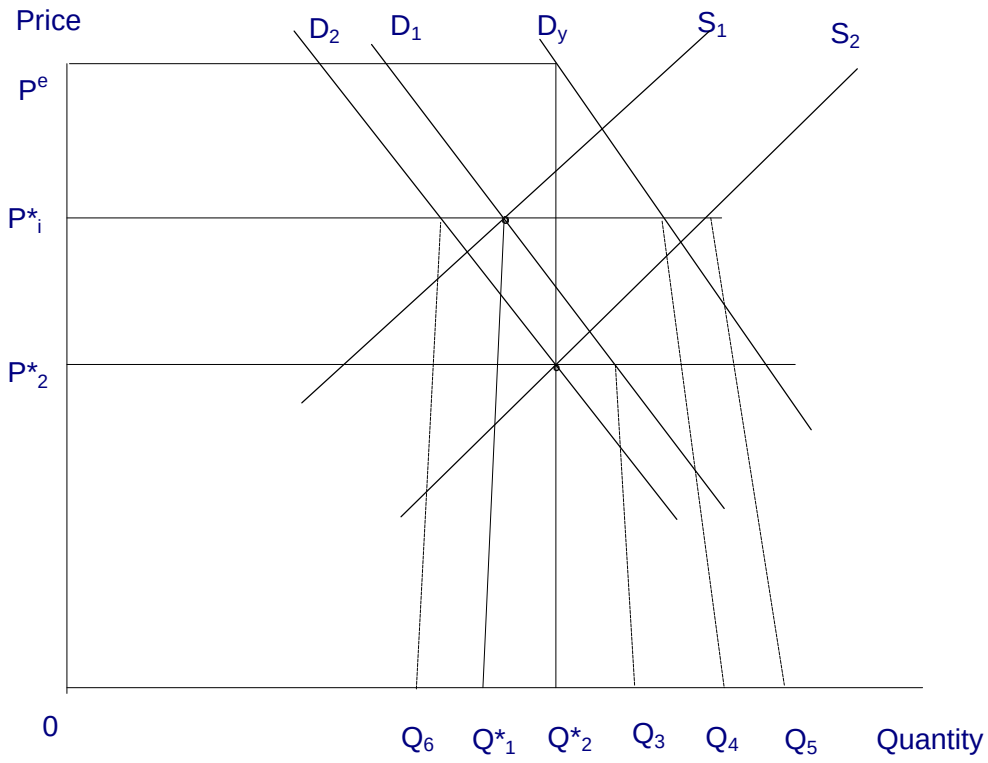
$$\frac{\delta QD_i}{\delta Z}\frac{Z}{QD_i} \quad e_3 \leq 0 \qquad \textbf{(8)}$$

$$\frac{\delta QD_i}{\delta Y}\frac{Y}{QD_i} \quad e_4 \geq 0 \qquad \textbf{(9)}$$

The deterministic exposition of the above relations is shown geometrically in figure 1.

The framework is based on the reality of a closed rice market in Bangladesh, at least for the period under analysis. Export of rice was banned, and import, when needed, was done only by the government for public distribution. Private trade in international markets was not allowed. However, Bangladesh shares a long border with India and smuggling of rice across borders is a strong possibility. The International Food Policy Research Institute has conducted an enquiry on this cross-border trade. This study has revealed that rice smuggling across borders is generally limited to local border markets. Out of 20 border markets studied, about 7 discerned price levels generally 5 to 10 percent lower in the Bangladesh side than the Indian side of the markets. Another 9 markets discerned price levels in the Bangladesh markets 3-9 percent higher than in the Indian markets. Four markets did not show any significant difference in the price of rice (Rahman et al 1994). The conclusion was that the cross-border trade was very small and involved two-way traffic. In the northern part of the border, some rice used to move to India, while in the southwest and southeast parts, some rice used to move into Bangladesh. Seizures of smuggled goods across borders also provide an indirect testimony to this pattern of cross-border trade. Moreover, the smugglers tend to focus on commodities that provide a larger scope of potential profit than rice. The extent of profit in cattle, sugar, salt, cloth, and a few other manufactured goods was found to be much larger than in rice. It is strongly believed that the smuggling of rice, even though small, varies from year to year. The use of trend supply rather than actual in any year

Figure 1--Comparative Static Framework for Rice Market



takes away some of the minor distortions in the measurement of supply that might be caused by cross-border trade.[2]

Even if there were no administrative ban on private trade in export or import of rice, it is doubtful whether an open economy model would have been more appropriate than a closed one in the context of the rice market of Bangladesh. Bangladesh has emerged as a marginally surplus producer of rice in recent years. In the early 1980s it was a marginal deficit producer. The domestic price of rice has fluctuated in most years of the last decade within the export and import parity prices (Rahman 1994). In such a situation, rice has been almost like a non-tradeable product in the sense of its tradeability in the world market. An open-trade model would perhaps be quite inappropriate in such cases.

The values of QS, QD, and Y are expressed in per capita terms in order to confound the effect of change in population. D_1 and S_1 are the respective demand and the supply curves in time 1, the initial year. Similarly, D_2 and S_2 are the respective curves in time 2, the final year. D_y is a hypothetical demand curve reflecting the effect of income growth, in isolation of other forces. The position of the D_2 reflects the net shift, i.e., the effect of Y minus the effects of Z, and P_j, and income distribution. The way D_2 has been drawn in the figure indicates that the combined negative effect of Z, P_j variables and income distribution is larger than the effect of Y in absolute terms. The effect of Z represents the effect of urbanization. For the sake of keeping close to the reality of Bangladesh, the effect of Z is shown to be negative. The position of D_2 could be at the left of D_1, just on D_1 or at the right of D_1 depending on whether this combined shift effect is greater than, equal to, or smaller than the shift due to increase in per capita income.

There are two factual points in the figure: (P_1^*, Q_1^*) and (P_2^*, Q_2^*)--the initial and final equilibrium points where the respective supply and demand curves of period 1 and 2 intersect. If the shift of D_2 were to the extent whereby it coincides with D_1 (implying no actual net shift), the actual consumption in that event would have been Q_3 at P_2^* price level. This would imply a higher level of consumption and a larger shift in the supply curve towards the right passing through the point (P_2^*, Q_3) rather than the point (P_2^*, Q_2^*). It should be noted that the framework provides an indirect way of measuring the extent of supply shift caused by technological progress in rice production.

The extent of horizontal shift in the demand curve due to increase in income can be measured by the difference of OQ_4 and OQ_1^*, i.e. (OQ_4 - OQ_1^*). The extent of leftward shift in demand due to the combined effect of Z and P_j variables and income distribution is measured by (OQ_4 - OQ_6). The extent of supply shift can be measured by (OQ_5 - OQ_1^*). The level of supply would have been OQ_5, if the economy were open and P_1^* were equal to world price.[3] At that

situation, consumption at the final period would have been much smaller, i.e., only OQ_6 and (OQ_5 - OQ_6) would have been the quantity exported.

The puzzle that has caused lengthy debate among economists working on Bangladesh and that still is causing some confusion among bureaucrats and professionals in Bangladesh (see Hossain 1994) can be illustrated through the figure. The final year consumption is observed at Q_2^* and price and P_2^*. But given the income growth as implied in the shift of demand curve to D_y, the price should have been at P_e instead of P_2^*. Therefore, it has been inferred that the income distribution must have worsened to cause the actual demand curve to shift to the position of D_2 instead of remaining at D_y.

The approach for deriving the inference was right but the apparatus for drawing the conclusion was incomplete without the inclusion of the plausible effects of urbanization and substitutions in consumption in the demand function. Such lapses are understandable, given that the context of past analysis was poverty analysis; the analysis of the rice market was only incidental to the main thrust of enquiry in the past analysis.

Like the approach adopted by Osmani (1993), I will also attempt to infer the possible negative effect on demand of a worsening income distribution. But I propose to do that after accounting for the effects of urbanization and other prices beside rice.

URE = urbanization effect estimated separately and discussed later
CPE = cross-price effect due to changes in the prices of other goods and services

If (OQ_4 - OQ_6) = (URE + CPE), then there is no change in income distribution.
If (OQ_4 - OQ_6) > (URE + CPE), then there is a worsening of income distribution, i.e., leftward shift of the demand curve exceeds the shift caused by Z and P_j effects.
If (OQ_4 - OQ_6) < (URE + CPE), then there has been an improvement in income distribution.

Let me now present a few formulas that will be used in the next section. The shift in demand due to income is as follows:

$$(OQ_4 \quad OQ_1) \quad Q_1(1 \quad \frac{\Delta Y}{Y} e_4) \quad Q_1 \qquad \textbf{(10)}$$

The shift in demand due to combined effects of Z, P_j, and income distribution is as follows:

$$(OQ_4 \quad OQ_6) \quad Q_1(1 \quad \frac{\Delta Y}{Y}e_4) \quad [Q_2(1 \quad \frac{P_2 \quad P_1}{P_2}e_1)] \qquad \textbf{(11)}$$

The shift in supply curve is as follows:

$$(OQ_5 \quad OQ_1) \quad Q_2\ (1 \quad \frac{P_1 \quad P_2}{P_1}\alpha_1) \quad OQ_1 \qquad \textbf{(12)}$$

All these assessments are based on linearity of relations and parallel shift of demand and supply curves. Although these assumptions may seem rather restrictive, the modest range of changes in quantity variables and the comparative static framework as the context of analysis may make these as less restrictive than they seem.

A final point concerning the use of the aggregate versus the marketed component of grain markets in a semi-commercial agriculture as an approach for the analysis of price and supply-demand relations has been raised by Chowdhury (1992). I believe that Osmani has adequately dealt with that issue showing that the two approaches do not result in any difference in the excess demand that is central to the analysis at hand (Osmani 1993).[4] I, therefore, propose to follow the aggregate approach, recognizing that the parameters used are also relevant to that approach.

THE EMPIRICS OF THE FRAMEWORK

Data

The empirical part of the analysis is based on trend values of price and quantity variables rather than actual values in period 1 (1983/84) and period 2 (1992/93). Because we are interested in aggregate, average, and long-run market relations, actual values inclusive of random fluctuations would have made the analysis and conclusions unnecessarily complex and unreliable. These trend values are presented in the appendix table A-1.

The supply of rice (Q_s) is measured as the domestic production minus internal procurement by the government plus off-take or distribution from

government stock. As mentioned earlier, import during the period of analysis was strictly limited to the government sector. Therefore, imported rice and the change in public stock are reflected in the off-take that is the net contribution of the government sector to market supply. This procedure of accounting total supply does not take into account the change in stock with private traders and farmers. This may appear as a weakness of the measure to represent the actual aggregate supply of rice in a year. This weakness is, however, more apparent than real. A recent study of the rice market of Bangladesh provides evidence that marketed supply and stock held by farmers and traders have increased in recent years compared to the past (Chowdhury 1992). However, most of the private stock was found in the study to be meant for seasonal markets; farmers held stock primarily for insurance against potential failure of the next crop and traders for making profit through buying at harvest and selling at peak price seasons. Public price stabilization programs prevent abnormal fluctuation in annual prices and this is a disincentive to private trade for holding stock for annual price arbitrage. Therefore, inter-year changes in stock with farmers and traders are expected to be minimal and randomly distributed in such situations. Therefore, the use of trend values in place of actual supply or availability is likely to take care of the random changes in inter-year stocks of rice by farmers and traders.

Recent price analyses in Bangladesh are mostly based on the price of coarse varieties of rice. This is generally because of the focus on high-yielding varieties that are largely of coarse quality. However, the BR-11 high yielding type and almost the entire local Aman varieties are of medium to fine quality.[5] Analysis of coarse and medium-quality rice prices shows that the prices of medium quality have not declined as much as the prices of coarse varieties. Therefore, the simple average of medium and coarse quality rice prices is computed to represent rice prices (P_i) for this paper.

In order to convert nominal prices into a real price series, a suitable deflator had to be used. Keeping in view the past controversy as to the appropriate deflator for the purpose (See Osmani and Chowdhury 1993), a non-rice consumer price index (CPI) was developed and used for deflating the nominal rice prices. For the purpose of this exercise, the CPI was further split into rice and non-rice deflators as shown below:

$$CPI = \delta * IRP + (1 - \delta) * INRC$$

where:
- CPI = Consumer Price Index
- IRP = Index of rice price
- INRC = Index of non-rice consumers price index
- * = Share of rice in the CPI

From the above equation one can estimate

$$INRC \quad \frac{CPI \quad (\delta \; IRP)}{1 \quad \delta} \qquad \textbf{(13)}$$

given that we know CPI, δ, and IRP.

The final results indicate that the annual trend growth rates of CPI, non-rice CPI, and the index of manufactured goods prices were 7.3, 8.1, and 5.8 percent, respectively, during the period of analysis. Prices of non-rice agricultural products and services seem to have increased faster than rice prices.

It appears from table A-1 that actual consumption (i.e., equilibrium of availability and disappearance) of rice in period 1 was 149 kg per capita per year cleared at price 7.61 (i.e., $Q_1^* = 149$, and $P_1^* = 7.61$). The corresponding figures for period 2 are $Q_2^* = 157.9$ kgs per year, and $P_2^* = 5.95$. Therefore, over the period, consumption or availability of rice per capita had increased by 6.0 percent and price in real terms decreased by 21.8 percent.

Demand-Supply Parameters

Income elasticity of demand for rice is one of the most critical parameters for the analysis. A certain amount of controversy has surrounded the traditional practice of using income elasticity of demand for staple foods derived from cross-section surveys of household expenditures (See Buis 1994; Behrman and Deolalikar 1987; Pitt, Rosenzweig, and Hassan 1990) for projection and price analysis. Two strands of arguments are raised in this literature. First, it is argued that the conventional household surveys are designed in such a way that the estimate of the income elasticity of demand for the staple becomes biased upward for a number of factors. For example, these surveys do not capture the intake of food by household members but record expenditures on food that generally are meant partly for guests, laborers, and charity in large households. The second strand of the argument concerns the secular downward shift of consumption function for staple foods due to structural changes such as commercialization, fall in activity levels, etc. The first argument will imply a reduction in slope and the second argument will imply a downward shift of the Engel Curve. There are definitely some valid points in these arguments, but for the present purpose there is no alternative but to stick to the available estimates of income elasticity from recent household surveys in Bangladesh.

The household expenditure surveys of Bangladesh were the basis of a report by the Bureau of Statistics (1991b). This report shows the estimates of rural income elasticities for rice of 0.63, 0.43, and 0.43 for 1983/84, 1985/86, and 1988/89, respectively. The estimates of corresponding urban income

elasticities were 0.33, 0.16, and 0.19. The national level estimates were 0.56 for 1983/84, 0.40 for 1985/86, and 0.30 for 1988/89.

Goletti (1994), using the raw data of the 1988/89 household expenditure survey (HES) of the Bureau of Statistics, has estimated the income elasticity (quantity as dependent variable) of various food items in Bangladesh. The estimate for rice is 0.35. Working with the raw data enabled him to discover numerous bugs (e.g., zero consumption or consumption implying several thousand kilocalories per person, etc.) in the data. It was found that without the careful examination of data, the estimates of income elasticity could be somewhat biased but not altogether useless. Talukder (1993) used the 1981/82 HES data (group averages of 67 districts) to estimate the income elasticity of foods. He found the demand elasticity of rice to be 0.51 but the elasticity estimate for foodgrains was 0.35. S. Ahmed, *et al*. (1985), working with a team of economists from the Wagenin University, Netherlands, estimated the income elasticity of rice to be 0.35. In a recent study based on about 600 rural poorer households, but employing a full demand system and AIDS (almost ideal demand system) model, Ahmed and Shams (1993) estimated the expenditure elasticity for rice to be 0.60 at sample mean level of income. Mahmud (1979) estimated the expenditure elasticity for food grains to be 0.55. The assortment of estimates of income and expenditure elasticities presented above vary from 0.30 to 0.60. Generally, the estimates of earlier years are larger than the estimates of later years, indicating a declining trend. Income elasticity is generally smaller than expenditure elasticity. Estimates of elasticity also tend to be smaller when the quantity of a commodity rather than the share or the expenditure on the commodity is used as the endogeneous variable. Moreover, differences in data, methodology, and specification of demand functions are quite likely to cause some difference in the estimates. Keeping in mind that the present analysis concerns current aggregate relations between quantity of consumption and real income, the estimate of income elasticity of 0.35 seems quite appropriate for the analysis at hand.

Own Price and Cross-Price Elasticities

Own price elasticity of demand is generally expected to be closer to income elasticity for a demand system satisfying homogeneity assumption. Studies on price elasticity are, however, fewer than the studies on income elasticity. Goletti's study estimates price elasticity of demand for rice at ¯0.7. S. Ahmed, *et al*., estimate the uncompensated price elasticity for rice at -0.32. Ahmed and Sham's study present an estimate of -0.45. Mahmud's estimate of the price elasticity was -0.39. For the purpose of the present analysis, I have used -0.5 as the own price elasticity of demand for rice.

Estimates of cross-price elasticity, defined as the changes in the demand for rice due to changes in all other prices, are available only from three sources as shown below:

Mahmud (1979):	-0.16
Chowdhury, O.H. (1982):	-0.23
Ahmed and Shams (1993):	-0.42

These estimates are the sum of cross-price elasticities of various commodities covered in the demand system. Mahmud and Chowdhury used the HES data, whereas Ahmed and Shams' study is based on a smaller rural household survey with higher weights for the poor. For the purpose of the present analysis, a cross-price elasticity of -0.25 is used.

The cross-price elasticities of food items are generally positive, indicating a relation of substitution with rice. Wheat is the most important substitute for rice but the cross-price elasticity of wheat is only 0.05. Cross-price elasticity of nonfood consumer goods is generally negative, implying that when prices of such products increase, ceteris paribus, demand for rice decreases because of the income effect of such a price increase.

Supply Elasticity for Rice

Research on supply response of rice in Bangladesh is extremely thin. Moreover, research on supply response is largely limited to short-run response. In the present analysis, the long-run supply response is more relevant than the short-run one. Nevertheless, short-run response can be taken as a lower bound of long-run relations. Shahabuddin and Zohir (1994) have recently completed an analysis that shows the short-run supply response of rice as only 0.08. A comprehensive study by Rahman (1986) estimated a long-run supply elasticity of Aman rice, the largest type of rice, at 0.3. The same study estimated the supply elasticity of Boro rice, the second largest rice crop, to be much larger, about 0.9 (Rahman, 1986, p.96). However, the supply elasticity of the third rice--the Aus crop--was zero. In the present analysis, a supply response of 0.2 is used.

A summary of the parameters used in the present paper is shown in Table 1.

ESTIMATED RESULTS

1. *Extent of shift of the demand due to change in per capita income* as in equation (10):

$$(OQ_4 \quad OQ_1) \quad Q_1(1 \quad \frac{\Delta Y}{Y} e_4) \quad Q_1 \qquad \textbf{(14)}$$

= 149 (1 + 0.192 * 0.35) - 149
= 159.0 - 149 = 10, or 6.7 percent of base year

2. *Effect of urbanization (URE) or the effect of -*:

The urbanization effect is represented by the difference in per capita consumption of rice between rural and urban areas at the same level of prices and per capita income. Observed per capita consumption in rural and urban areas, when adjusted for the observed differences in prices and average income, provide the basis for estimating the urbanization effect. However, this measure of urbanization effect has to be combined with the effect of changed shares of urban population over time to arrive at the total urbanization effect. We have information on the urban-rural rice consumption, prices, and income for three years. Using this information, the URE is estimated as follows:

Q_r = average per capita rural consumption,
Q_u = average per capita urban consumption,
Y_r = per capita rural income,
Y_u = average per capita urban income.
$\hat{e}_4$ and $\hat{e}_1$ are urban income and price elasticities.
Any variable pre-fixed by adj. means adjusted.
$\Delta P/P$ =percentage difference between urban and rural prices and it is negative, implying rural prices are lower than urban rice prices.

$$adj\ Q_u \quad Q_u\ (1 \quad \frac{Y_u \quad Y_r}{Y_u}\ \hat{e}_4) \quad Q_u(\frac{\Delta P}{P}\ \hat{e}_1) \qquad \textbf{(15)}$$

The first element of the right side is the adjustment for income difference and the second element for price difference. Estimates are shown in table 2.

Table 1--Parameters Selected for Use

Parameter	Bangladesh	Rural	Urban
Income elasticity of demand	0.35	0.48	0.21
Price elasticity of demand (own and uncompensated)	-0.50	-0.51	-0.54
Supply elasticity	0.20	--	--
Cross-price elasticity of demand for rice with respect to other goods	-0.25	--	--

Source: Author's judgement on the basis of the following studies: 1) Bangladesh Bureau of Statistics, 1991b; 2) Talukder, 1993; 3) S. Ahmed, 1985; 4) Mahmud, 1979; 5) Akhtar and Shams, 1993; 6) Goletti, 1994; 7) O. H. Chowdhury, 1982; 8) Shahabuddin and Zohir, 1993; and 9) S. H. Rahman, 1986.

Table 2--Adjusted Consumption of Rice in Urban and Rural Areas (Adjusted for Income and Prices)

	1983/84		1985/86		1988/89	
	Rural	Urban	Rural	Urban	Rural	Urban
Actual income (TK) (Y_r, Y_u)	3883	5110	4967	7420	5805	9034
Consumption (gms/cap/day) (Q_r, Q_u)	420	351	454	376	451	390
$\Delta P/P$ (%)	10		9.5		9.1	
adj. Q (Q_r, Q_u)	420	352	454	369	451	381

3 *Year Average* ($\overline{Q}_r$, $\overline{Q}_u$) $\overline{Q}_r$ 441 $\overline{Q}_u$ 367

($\overline{Q}_r$ $\overline{Q}_u$)

Difference of 3 year average =
= 441 - 367 = 74
(or 20 percent of urban average consumption)

Source: Actual values computed from information in Bangladesh Bureau of Statistics 1991b, and Goletti 1993.

The three year average is taken in order to minimize the error that is likely to be present in a single observation. This is consistent with the overall approach of analysis based on trend values as far as possible.

The next step is to incorporate the rural-urban rice consumption statistics $(\overline{Q}_r \quad \overline{Q}_u)$ in table 2 in the estimation of the total urbanization effect in the consumption of 1983/84 and 1992/93--the initial and final points of the comparative static analysis. This estimation will capture the contribution of the change in urbanization over the period. The trend of urbanization seems to be growing at an exponential rate in Bangladesh (World Bank 1994). The proportion of urban population was about 6 percent in 1973/74, 10.7 percent in 1983/84, and 24.5 percent in 1988/89 (World Bank 1994; BBS 1991b). An extrapolation of adjusted past trends indicates that the proportion of urban in total population would be about 33 percent in 1992/93.[6] While one could spend more time in fine-tuning this estimate, for the purpose of the present exercise, this 33 percent figure is used in the estimation of total urbanization effect.

The period of analysis estimate is provided following the formulation presented below.

$\overline{Qu}$, $\overline{Qr}$ are long-term urban and rural consumption. As a result of urbanization, consumption per capita changes. If $\left(\frac{Q}{N}\right)_t$ denotes consumption per capita at time *t*, where *N* is total population, then

$$\left(\frac{Q}{N}\right)_t \quad \overline{Qu}\, a_t^u \quad \overline{Qr}\left(1 \quad a_t^u\right). \qquad \textbf{(16)}$$

Where a_t^u is

$$\left(\frac{Q}{N}\right)_2 \quad \left(\frac{Q}{N}\right)_1 \quad \overline{Qu}\left(a_2^u \quad a_1^u\right) \quad \overline{Qr}\left[\left(1 \quad a_2^u\right) \quad \left(1 \quad a_1^u\right)\right] \qquad \textbf{(17)}$$

the urbanization rate at time *t*, then

$$\left(\overline{Qu} \quad \overline{Qr}\right)\left(a_2^u \quad a_1^u\right)$$

= 74 * (0.33 - 0.11)
= 16.3 grams/capita/day, or 5.95 kg/capita/year, or 4 percent of base year level.

3. *The Cross-price effect (CPE)*

In calculation of the cross-price effect, the change in non-rice GDP deflator relative to rice prices is the relevant price change. This is the inverse of the rice price relative to the non-rice GDP deflator used earlier to measure the real price of rice. This universal index is the relevant index of other prices (P_j).

Therefore, the estimate of CPE = (0.279 * 0.25) = 0.07, or 7.0 percent of base year consumption, and it is negative.

4. *The actual shift in demand* due to combined effect of urbanization (Z), cross-price effect (P_j), and possible change in income distribution, using equation 10:

$$(OQ_4 \quad OQ_6) \quad Q_1\left(1 \quad \frac{\Delta Y}{Y}e_4\right) \quad \left[Q_2\left(1 \quad \frac{P_2 \quad P_1}{P_2}e_1\right)\right] \qquad \textbf{(18)}$$

= 149 (1 + 0.192 * 0.35) - [157.9 (1-0.28 *0.5)]
= 159 - 135.8 = 23.2, or 15.6 percent of base year level.

5. *The effect of technological factors*

Using equation 12:

$$(OQ_5 \quad OQ_1) \quad Q_2\left(1 \quad \frac{P_1 \quad P_2}{P_1}\propto_1\right) \quad Q_1 \qquad \textbf{(19)}$$

= 157.9 (1 + 0.218 * 0.2) - 149
= 164.8 - 149 = 15.8 or 10.6 percent of base year level.

The importance of this 10.6 percent shift of the supply curve bears important significance for consumption and price levels. The level of per capita consumption of 157.9 kg in 1992/93 would have not been possible at the 1992/93 actual price if the supply curve did not shift to the right. If the supply curve were to remain at its 1983/84 level, then the 1992/93 consumption level would have definitely fallen below the 157.9 kg, and possibly below 149 kg (i.e., the actual level of 1983/84). I say possibly, because the shift of the demand curve might also have been affected through the changes in cross-price relations.

Is Income Distribution the Culprit?

Now it is possible to pool all the pieces presented so far to conclude whether a worsening income distribution caused the prices of rice to fall on the face of a rising per capita income.

The contributions of various factors in the movement of the demand for rice are summarized in the table 3.

Given the parameter values, this analysis clearly shows that a modest worsening of income distribution in 1992/93 compared to 1983/84 adversely affected the demand for rice. The combined effect of urbanization, cross-prices, and income distribution not only canceled the effect of increased income on per capita demand for rice but it depressed the demand further down. However, the impact of a worsening income distribution effect was responsible for about 29 percent of all demand depressing factors. Its absolute impact was roughly 6.8 kg of rice per capita per year, which is about 4.6 percent of the base year consumption of rice.

CONCLUDING OBSERVATIONS

During the decade from 1982/83 through 1992/93, Bangladesh was able to increase the production of rice, its staple food, at a rate modestly higher than the population growth. Substitution of import by domestic production resulted in even a slower growth in per capita supply than in production. On the other hand, per capita GDP increased by about 2 percent per annum. Nevertheless, real prices of rice sharply declined. This raised suspicion whether income distribution had twisted against the poor who have higher marginal propensity to consume rice than the rich.

Assuming that the parameters used in the analysis are correct, this paper shows that the combined negative effects of a number of other factors not only swamped the positive effect of the increase in income on demand for rice, but depressed the demand further down on a substantive scale. Three such factors are listed: (a) urbanization, (b) cross-price effects, and (c) worsening income distribution. The analysis shows that, of a total demand depressing effect of 15.6 percent, urbanization accounts for 4 percent points, cross-price effects account for 7 percent points, and worsening income distribution accounts, residually, for 4.6 percent points.

The findings of the analysis bears a number of policy implications with immense consequences. *First*, food production policies of developing countries focused on long-term growth in staple foods, often reflected in projections, have to be carefully reevaluated with more analysis of demand factors and emphasis on demand policies than done in the past. Such projections based on changes only in income and population overstate the growth of demand. Various structural changes cause a sluggish growth in demand for staple grains.

Table 3--Contribution of Factors to the Shift of Demand for Rice, 1983/84-1992/93

Factors	Absolute shift (kg/capita)	Shift in percent of 1983/84 base	Direction of shift
Income	10	6.7	+
Urbanization	5.95	4.0	-
Cross-price changes	10.43	7.0	-
Combined effect of Z, P_j, and income distribution	23.2	15.6	-
Income distribution (as a residual)	6.82	4.6	-

Source: Computed by author.

Second, the analysis demonstrates that the cross-price effect, mainly the income effect of rising prices of other goods and services than staple food, can have a tremendous negative impact on the demand for staple. This implies that a broad-based growth is required so that other prices do not divulge too much from foodgrain prices. Of course, when domestic production conditions are not very congenial for a broad-based growth, an open market policy could essentially satisfy the same objective, by preventing the prices of other goods and services from rising too much.

Third, consequences of a worsening income distribution can not always be tackled in a neutral fashion. But being aware of the problem and striving for correction of the demand deficiency arising from a worsening income distribution is winning half the battle. For example, the identification that most of the agricultural growth in Bangladesh has come from irrigated HYV rice, which is limited to only about 40 percent of land and farmers, has generated new efforts for diversification in areas where HYV can not be grown. Increased rice production through only 40 percent of land and farmers has depressed prices for all farmers. Those who grow HYV are compensated for the low price by higher productivity. But those not favorably positioned for growing HYV do not enjoy higher productivity, but lose on account of lower prices caused by the increased production of a small group of farmers. This is a potent cause of worsening income distribution.

Finally, the objective measurement of the extent of supply-shift due to technology in rice production clearly reinforces the foundation of technological route for increasing production that benefits both consumers and producers. Without such a means available to the farmers of Bangladesh, the level of consumption of rice would have been much smaller than what it is now.

ENDNOTES

1. Rice contributes about 80 percent of the total caloric intake of Bangladesh households.

2. The indirect estimate of per capita consumption of rice following the aggregate approach of production minus public procurement plus public distribution is 408.2 grams per day in 1983/84. The direct estimate obtained from Household Expenditure Survey for the same year is 411 grams. The difference between the two is less than one percent. This insignificant difference can be considered as evidence of the validity of the indirect approach providing a credible measure of the aggregate supply of rice.

3. Import parity border prices of rice have been 2 to 15 percent higher than the domestic prices during the period of 1983/84 through 1992/93 (Rahman 1994).

4. Let total supply and demand be denoted by S_t and D_t, respectively, and their marketed components by S_m and D_m. Also, D_s denotes subsistence demand (i.e., the part of demand that is met without recourse to market) and S_s the part of total supply that is not marketed). By definition, $D_s = S_s$. Clearly, $D_t = D_m + D_s$ and $S_t = S_m + Ss$. Therefore, $D_t - S_t = D_m + D_s - S_m - S_s = D_m - S_m$. Hence, $D_t - S_t \rightarrow 0$. Thus, any overall excess demand must entail a "market" excess demand of exactly the same sign and magnitude.

5. Bangladesh produces rice in three seasons: *Aman* season rice is harvested in December-January; *Boro* season rice is harvested during April-June; and *Aus* season rice is harvested during July-September. BR-11 is a high-yielding variety grown in *Boro* season.

6. The Bangladesh Bureau of Statistics (BBS) defines urban population as the population living in municipal areas. Due to institutional rigidity, constitution of a municipality lags behind the pace of change in occupational status. If non-agricultural occupation of population, that entails a lower activity level than agriculture, were the basis of the definition of urbanization, the rates of urbanization for the 1970s and early 1980s would have been higher than the estimates made by the BBS. The use of the municipality criterion has resulted in the exclusion of many urban-like rural towns and business centers from being considered as urban areas, particularly during the earlier years. Recent reorganization of districts and creation of new municipal areas have corrected this anomaly. Upward adjustment of urbanization rates for earlier years would give a picture of less sharp increases in urbanization than the rates quoted in the text.

Appendix Table 1--Trend Values of Relevant Variables

Variable	1983/84	1992/93	Percent change over the period	Percent of annual rate of change[3]
Per capita supply or availability of rice (kg)	149.0	157.9	6.0	0.64
Population (000)[1]	95,918	117,437	22.4	2.21
Real price of rice[2]	7.61	5.95	-21.8	-2.7
Non-rice CPI	94.6	196.4	106.6	8.1
Per capita GDP at constant prices (TK)	4044	4820	19.2	2.0

Sources: Bangladesh, Bureau of Statistics, Statistical Yearbooks, 1991 and 1995; and World Bank, 1996.

Notes: [1] Census population of 1981 and 1991 (adjusted for undercounting) was the basis of calculation. However, census population relates to the count on January 1 of any years. These figures were converted to the estimated count on July 1 by taking the average of two calendar years that encompassed the financial year.

[2] Rice price in taka per quintel deflated by the non-rice CPI.

[3] Annual rate of change is = $(\text{Ln } Xt_2 - \text{Ln}Xt_1)/9$

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