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Farmers' Supply Response to Prices and Non-Price Factors in Bangladesh[1]

This Policy Brief examines the supply response to price and non-price factors and makes policy recommendations for sustained growth of crop production in Bangladesh.

1. Background

Farmers of Bangladesh grow crops not only for meeting subsistence needs but also for cash needs. In their pursuits, farmers respond in varying degree to incentives in the form of prices they receive for their products. The prevailing prices at which farmers can sell their products are the outcome of complex market structure shaped and sometimes reshaped by the domestic and external policy environment as well as non-price factors. These policy environments may propel or hinder farmers' responsiveness to price signals.

Agricultural policy in Bangladesh underwent remarkable metamorphosis over the last three decades. The government started phasing out subsidy on fertilizer since the mid-1970s and completed in the mid-1980s. These reforms essentially reduced the budgetary burden of the successive governments and transformed regulated fertilizer market into a competitive one. At the same time, the successive reduction in subsidy resulted in manifold increase in the price of fertilizer.

While in the early 1980s the publicly owned irrigation equipments were sold to the private parties through special credit facilities, during the late 1980s restrictions on import of engines for irrigation pumps as well as standardization limiting the makes and models were withdrawn. Even though liberalization led to increase in the costs of irrigation and prices of irrigation equipment in the 1980s compared with that in the 1970s, it substantially influenced growth of rice production in the 1990s.

Since the early 1990s, the country experienced a liberalized trade regime. Recognizing that general and specific liberalization policy changes would raise the costs of production to the farmers, the government also introduced a policy of price support for rice and wheat through public procurement, and a rapid expansion of agricultural credit through specialized financial institutions.

The rationale behind agricultural liberalization is that the biases against agriculture discourage production so that the reforms will encourage producers to respond. Attempts have been made to analyze how farmers respond to the ensuing price signals and risks, especially which element of risks viz. price risk, yield risk, or revenue

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risk matter most and how their responses vary between the short and the long run.

The three types of rice account for more than 70 percent of the country's gross cropped area (Table 1). While the share of area under aus declined to less than 10 percent, that of aman remained stable at around 40 percent, and that of boro increased to less than 30 percent of the gross cropped area. It is interesting to note that the relative importance of aus and boro during the beginning of the new millennium is the mirror-image of the 1970s, reflecting, by and large, an interchange in acreage allocation. Since the share of acreage under rice remained stable at 70 percent during the last three decades, it may imply that there was hardly any substitution of land between rice crops and non-rice crops in recent years as it happened in the 1970s. The relative importance of minor crops either remained stagnant or diminished over time.

Table 1: Relative importance of the major crops in gross cropped area

(in percent)

Crops	1972/73-79/80	1980/81-89/90	1990/91-99/00	2000/01-08/09
Aus	26.13	21.35	11.97	7.85
Aman	46.55	39.85	39.05	38.95
Boro	8.54	11.81	20.38	27.97
Wheat	1.59	4.22	5.06	4.00
Pulses	1.89	3.32	3.72	2.25
Oil Seeds	2.13	3.19	3.38	2.15
Spices	1.17	1.02	1.15	1.97
Vegetables	0.48	0.55	0.73	0.99
Potato	0.73	0.55	0.90	1.88
Jute	6.08	4.86	3.72	3.01
Tobacco	0.42	0.37	0.25	0.22

Source: Authors' calculations based on BBS data.

It may be noted that the annual growth in acreage under aus is estimated to be -3.92 percent for the whole period under consideration (Table 2). During the same period, the growth in yield was estimated at 1.86 percent. Thus, the positive growth in yield had offset somewhat the decline in production of the crop. Aman registered negative but marginal growth in both area and price during the period. Against this backdrop, the crop witnessed secular growth in yield due to gradual expansion of the HYVs throughout the period. The most spectacular growth in rice acreage was observed for boro. The high growth of yield and hence devotion of more acreage under HYVs of boro can largely be attributed to availability of irrigation facilities.

Table 2: Trends in area, yield, and price of crops

(growth rates in percent)

Crops	1972/73-2008/09			1972/73-1990/91			1991/92-2008/09		
	Area	Yield	Price	Area	Yield	Price	Area	Yield	Price
Aus	-3.92	1.86	-0.43	-1.61	0.23	0.39	-4.09	2.99	-1.58
Aman	-0.11	1.83	-0.07	-0.50	1.73	-0.34	0.00	1.86	-0.24
Boro	4.79	1.72	-0.22	5.13	1.56	-0.60	3.36	2.40	0.13
Wheat	3.41	1.34	1.02	10.44	3.46	-0.47	-2.74	0.08	1.78
Lentil	1.88	0.92	3.15	8.81	0.74	3.44	-5.28	0.62	1.85
Chick Pea	-1.17	0.78	2.86	1.17	0.15	4.73	-5.54	0.75	0.18
Black Gram	-2.37	0.22	2.66	2.48	-0.39	2.71	-8.17	0.40	0.70
Chickling Vetch	1.56	0.57	2.19	7.82	-0.23	2.61	-5.91	1.01	1.53
Rape & Mustard	1.02	1.04	-0.17	4.75	0.82	-1.71	-2.53	1.47	-0.62
Linseed	-1.71	0.87	0.99	13.28	1.75	0.76	-17.04	-0.73	-1.09
Sesame	-1.18	1.31	0.05	4.06	0.63	-0.28	-6.67	2.91	-1.81
Chili	1.97	1.79	2.22	-0.81	0.69	3.95	4.81	2.73	-0.90
Onion	2.67	0.82	3.66	0.61	-0.79	6.38	8.40	3.91	1.86
Garlic	2.05	0.39	2.94	0.10	-0.57	6.72	6.61	2.13	-1.21
Turmeric	1.26	3.03	0.96	1.51	2.15	1.57	2.16	4.97	-2.62
Ginger	1.35	-0.01	2.00	1.66	-0.49	3.20	1.56	1.86	0.43
Brinjal	2.44	0.05	2.76	0.51	-0.14	4.68	3.86	0.35	0.99
Arum	4.80	0.18	1.27	5.75	-1.10	4.48	3.77	1.12	-1.57
Cabbage	3.09	1.40	1.75	2.58	0.94	3.06	3.73	2.08	-2.44
Cauliflower	3.05	0.74	1.05	3.09	1.24	4.88	3.69	1.29	-2.13
Tomato	2.84	-0.26	3.37	2.80	0.08	5.96	3.71	-0.19	-2.29
Radish	2.66	0.76	0.80	4.10	0.98	-1.43	1.66	0.47	2.31
Beans	3.63	-0.08	2.90	3.22	-0.69	5.56	3.91	0.86	-0.38
Potato	4.00	1.55	1.44	-1.72	1.78	-0.98	9.77	1.43	1.36
Sweet Potato	-2.39	-0.56	2.38	-1.83	-0.20	1.44	-2.49	-0.26	3.12
Jute	-1.89	1.14	0.07	-1.22	1.04	0.14	-1.80	1.00	1.27
Tobacco	-1.97	1.31	1.36	-0.71	-0.01	-1.95	-1.41	2.11	1.12

Source: Authors' calculations based on BBS data.

Note: The trend growth rates have been computed by fitting semi-log function to the data.

The minor crops belonging to pulses, spices, oil seeds, and vegetables experienced impressive positive growth in price and yield. Thus most of the minor crops experienced positive growth in production and revenue. This may be attributed to sustained effort for crop diversification in the country.

2. A Brief Outline of Methodology

A simple Nerlovian-type acreage response model has been used in this analysis. The cointegration has been applied to a comprehensive set of time series data on acreage, output and prices of various crops published by the Bangladesh

Bureau of Statistics (BBS). In actual estimation, price risk, yield risk and revenue risk as well as domestic and external variables were incorporated, in addition to price and yield as dictated by the conventional Nerlovian model. The novelty of the analysis is the distinct estimates of the long-run and short-run parameters. It was found in all the cases that a long-run equilibrium exists. However, the extent of error correction mechanism is weak, as the error correction term is marginally significant in many cases.

3. Summary of Empirical Findings

The elasticity estimates for the rice crops imply that a 10 percent increase in price would lead to 7.3 percent increase in aus acreage, 5.6 percent in aman acreage, but 10.3 percent in boro acreage in the long-run (Table 3). The corresponding estimates vary between 3.2 percent and 1.8 percent in the short-run. Among rice, aus and boro switch their ranks in the short-run price responsiveness. Almost similar phenomenon is observed in the case of yield elasticity estimates. While the corresponding yield elasticity estimates are higher except for aus in the short-run, the gap between the price and yield elasticity has to some extent been reduced compared with what was found in the previous studies. In the long-run, however, the estimated yield elasticities exceed price elasticities for rice crops in all three seasons.

Table 3: Estimates of price elasticity and yield elasticity of crops

Crops	Price Elasticity		Yield Elasticity	
	LR	SR	LR	SR
Aus	0.734	0.321	0.755	0.287
Aman	0.564	0.280	0.628	0.394
Boro	1.031	0.183	1.341	0.362
Wheat	1.026	0.491	0.965	0.553
Lentil	0.516	0.392	-	-
Chick Pea	0.234	0.184	0.510	-
Black Gram	1.024	0.462	0.972	-
Chickling Vetch	0.640	0.213	0.462	0.373
Rape & Mustard	0.697	0.293	0.373	-
Linseed	0.596	0.420	0.757	-
Sesame	0.890	0.172	0.684	-
Chili	0.991	0.238	-	-
Onion	0.379	0.227	1.754	0.974
Garlic	0.990	0.368	0.713	0.579
Turmeric	0.448	0.340	-	0.351
Ginger	0.346	0.118	0.932	-
Brinjal	1.420	0.326	-	0.697
Arum	0.992	0.048	0.630	-
Cabbage	0.410	0.262	0.793	-
Cauliflower	0.469	0.109	1.455	0.845
Tomato	0.981	0.249	1.969	0.211
Radish	0.386	0.048	0.920	-
Beans	0.578	0.136	1.267	-
Potato	1.951	0.539	3.124	0.266
Sweet Potato	0.045	0.071	-	-
Jute	1.179	0.445	-	-
Tobacco	0.623	0.222	-	-

Source: Authors' calculations.

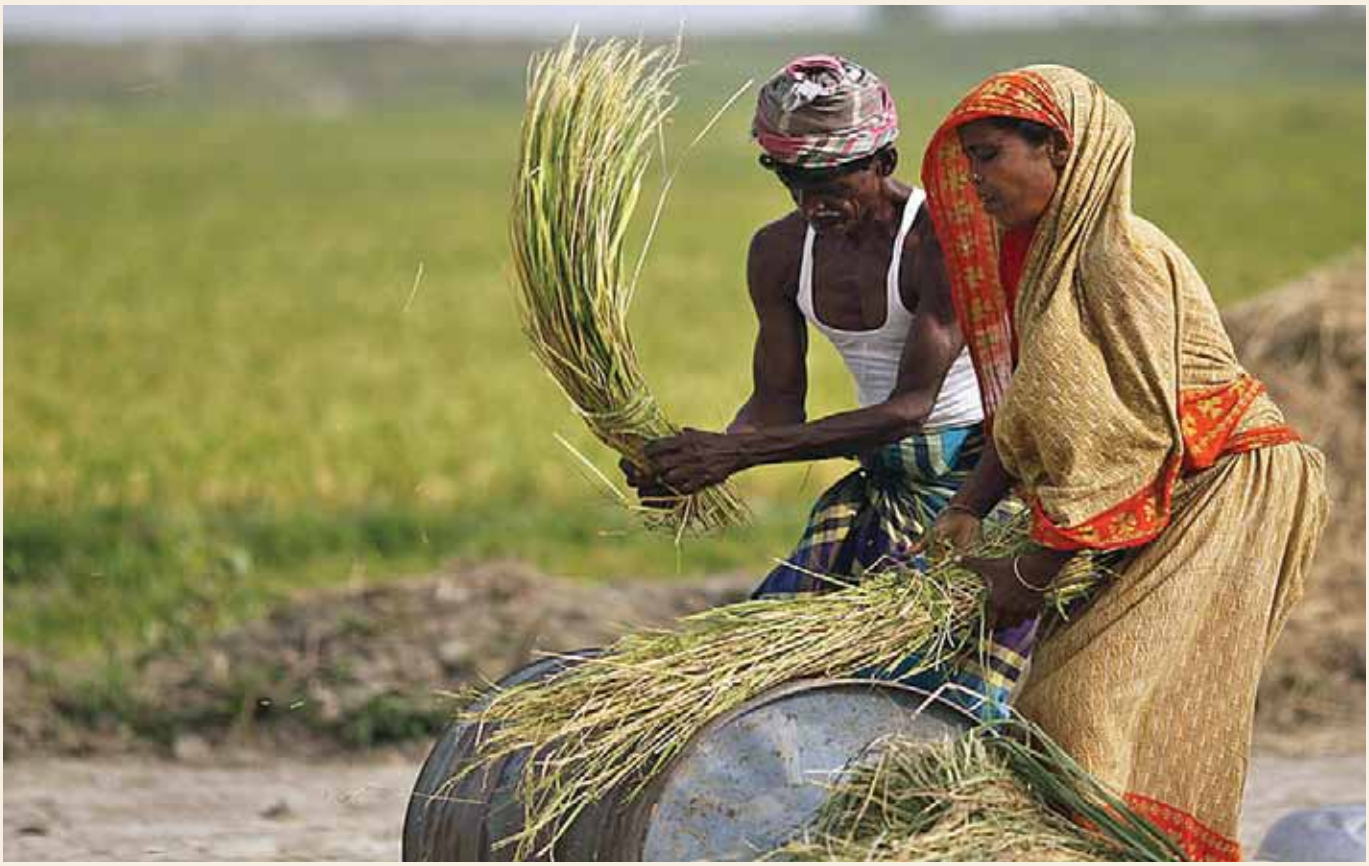
Note: The elasticities were calculated at the mean values of the variables using estimated coefficients.

Table 4: Estimates of price, yield, and revenue risk elasticities of crops

Crops	Price Risk		Yield Risk		Revenue Risk	
	LR	SR	LR	SR	LR	SR
Aus	-0.464	-0.013	-1.135	-0.017	-0.722	-0.017
Aman	-0.236	-	-0.282	-0.073	-0.241	-0.025
Boro	-0.993	-0.019	-1.027	-0.204	-	-0.045
Wheat	-0.596	-	-0.459	-0.070	-1.770	-
Lentil	-0.159	-	-0.086	-	-0.186	-
Chick Pea	-0.622	-0.163	-0.181	-0.072	0.534	0.090
Black Gram	-	-	-1.220	-0.110	-0.779	-
Chickling Vetch	-0.171	-	-0.269	-	0.297	-
Rape & Mustard	-0.043	-	-0.025	-	-0.346	-
Linseed	-	-	-	-	-0.537	-0.056
Sesame	-	-0.246	-0.124	-	-0.981	-
Chili	-	-	-	-	-0.811	-0.231
Onion	-0.738	-	-0.888	-	-1.296	--
Garlic	-0.225	-	-0.636	-	-0.411	0.069
Turmeric	-0.175	-	-	-	-	-
Ginger	-0.085	-0.024	-0.177	-0.052	-	-
Brinjal	-0.564	-	-1.144	-	-	-
Arum	-0.167	-	-0.244	-	-0.085	-
Cabbage	-0.266	-	-0.394	-0.030	-0.361	-
Cauliflower	-0.302	-0.028	0.053	-0.049	-0.251	-
Tomato	-0.404	-	-1.116	-	-0.600	-
Radish	-0.239	-	-0.313	-0.026	-0.249	-
Beans	-	-	-0.025	-	-0.069	-0.014
Potato	-1.279	-0.093	-0.876	-0.215	-	-
Sweet Potato	-0.012	-	-0.050	-	0.022	-
Jute	-1.449	-0.153	-	-	-1.854	-0.124
Tobacco	-0.262	-	-0.069	-	-0.233	-

Source: Authors' calculations.

Note: See note under Table 3.



As in the case of price elasticity and yield elasticity estimates, the risk elasticity estimates could not be derived for some crops for certain type of risk due to lack of precision of the underlying coefficient estimates. It may be noted that most of the elasticity estimates of any of the three types of risks are negative, implying that farmers in general are risk averse (Table 4). There is no systematic variation in the type of risk; for some crops price risks dominate while for others yield risks do. However, for crops if either price risk or yield risk dominates, revenue risk dominates, as well.

Farmers experience higher price risks for jute, potato, and boro; higher yield risks for black gram, aus, brinjal, and tomato; and higher revenue risk for jute, wheat, and onion in the long run. As expected, the short-run risk responsiveness is lower than their long-run counterparts, whenever such parameters could be ascertained with precision of the coefficient estimates. The high level of risks for some of these crops erode the extent of high price or yield responsiveness making the ultimate outcome at best modest.

4. Policy Implications

Since the escalation of risk (be it price risk or yield risk) tends to erode the positive benefits of increased price and yield effects on acreage, the government needs to make appropriate policy interventions to minimize such risks. The policy instruments to alleviate the undesirable consequences of risk aversion in general and risk minimizing behavior in particular may be classified, under two broad categories: (a) Policies specific to agricultural risk, which include crop insurance, relief, and famine policies, pure buffer stock or price stabilization schemes and flood protection measures; (b) Policies which are not risk specific, that include subsidization of inputs and/or credit, agricultural price support as income policy, reduction of background risk such as irrigation investments, increased efficiency of markets, improved access to information about technologies, improved non-agricultural job opportunities, especially through non-farm activities, land reforms and other income/wealth redistributive measures (Binswanger 1979).

Among the set of policies specific to agricultural risk, the role of crop insurance assumes special significance. It is well known that since the administrative costs associated with such schemes are quite high especially when dealing with large number of small farmers, the adoption of crop insurance schemes is economically justified only if there are sizeable allocative benefits to be reaped to offset their large administrative costs.

Most developing countries – Bangladesh is no exception – usually resort to relief policies to deal with consequences of

natural disasters. These include land revenue concessions, rural works programs to supplement loss of farm incomes and direct supplies of food and other relief materials. Given the predominance of such programs to deal with disaster situation in the policy packages of these countries, a thorough economic appraisal of such schemes is indeed necessary to suggest, in particular, how to improve their efficiency impact on the economy.

Another way of reducing the insufficiency stemming from risk aversion among farm households is to provide subsidized credit to those households whose access to institutional sources of credit is rather limited. The availability of such credit, especially in terms of distress, through a reduction in the consequence of losses, will have the effect of making the farmers less risk-averse in their input choices.

Buffer stocks and other price stabilization schemes represent yet another set of policy instruments to deal with the undesirable consequences of risk aversion in agriculture. This assumes special significance in the context of Bangladesh agriculture in view of the empirical evidence of greater random variability associated with prices than with those corresponding to outputs of various crops.

Finally, the role that the existing agricultural institutions play in diffusing the risk in a peasant economy needs to be recognized. It is now widely recognized that the institutions of sharecropping tenancy and rural credit markets contribute significantly to reducing the cost of risk bearing in such economies by spreading risk over different economic agents. In this context, in addition to the role played by share tenancy and rural credit markets, one should add the role of land and labor markets which contributes to risk diffusion in a number of ways. Thus even if risk aversion is found to be important, the burden of risk may be sufficiently diffused in the economy through existing social and economic institutions so that any government interventions to further diffuse the risks may not generate sufficient efficiency benefits to justify the cost of such interventions.

In addition to undertaking of policies/programs to minimize the undesirable consequences of risk aversion, direct policy interventions should be made to enhance the acreage response with respect to yield through public investment in research and extension. Bangladesh should invest in research and extension in agriculture to increase total factor productivity in the sector since the benefit cost ratio of this investment can be as high as 16:1 (Mudahar and Ahmed 2010). At present Bangladesh spends about 0.3

percent of agricultural GDP to research against the general recommendation of about 2 percent (World Bank 1981). Increase in expenditures on research will contribute to low cost supply of crop products by increasing yields and help farmers diversify production of crops by shifting from rice to high value crops.

The extension system needs to be revamped so that it is more demand-driven and responsive to the farmers' needs. The extension staff should be equipped with the most recent information on improved technologies and skills to work with farmers to help them solve location-specific problems.

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