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ELASTICITY OF DEMAND FOR FERTILIZER AND ITS IMPLICATION FOR SUBSIDY

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I

In a recent study Khan et al. (1980) concluded that demand for fertilizer in Bangladesh was influenced more by non-price factors e.g. HYV acreage, irrigated acreage etc., than by price. They estimated a demand function for fertilizer using aggregate time series data on fertilizer sales as the dependent variable for 1968-78. The estimated price elasticity was 0.17. They argued that subsidy on fertilizer did not contribute much to the growth of fertilizer use and that such subsidy constituted a heavy burden on the public exchequer, so subsidy could be reduced or eliminated without affecting demand (for similar views see, Islam 1980).

These types of arguments have been actually used to reduce subsidy in recent years (see, GOB 1978). So it is necessary to verify the validity of this estimate. There are a number of limitations of this study. First, price of fertilizer and its supply are institutionally determined. Second, during the ten year period, fertilizer sales increased consistently up to a certain period, then decreased for a brief period then increased again. The decrease in the intermediate period was due solely to supply constraint and official prices of fertilizers were not changed at that time to reflect relative scarcity (Jabbar 1981). Third, over this ten year period prices of fertilizers were increased only 4 times. Thus both the price and quantity series were rising but the price series was quite stable. Under these circumstances accurate estimation of price elasticity of demand may not be possible.

In this note, results of a cross-section study verifying the importance of price as a determinant of fertilizer demand are presented. Data were collected for one year in 1980 from a sample of 100 farms in Dariapur, a village in Rangpur district.

II

All the one hundred sample farms used at least some amount of fertilizer in some crop in the survey year and 70 percent of the total cropped area received some fertilizer (Table1). The degree of fertilizer adoption varied between crops, being quite high for all the rice crops and wheat, and low for other crops.

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Table 1: Degree of Fertilizer Adoption in Different Crops Produced by the Sample Farms

Crop	No. of produ-cers	Acres per produ-cer	% produ-cers using fertilizer	% of crop fertili-zed	% of users applying			% of users applying recommended rate
					Only Urea	Urea, TSP& MP	Urea, MP	
T.Aman	99	2.80	93	81.2	63	16	21	–
Aus	92	1.70	86	81.7	80	16	4	25
Boro HYV	30	0.63	100	100.0	17	73	10	36
Boro LYV	21	0.67	76	56.4	50	44	6	25
Wheat	66	0.70	96	95.2	35	44	21	13
Jute	62	0.65	63	60.1	71	20	9	24
Mustard	23	0.36	52	62.0	25	42	33	33
Kaun	16	0.64	38	31.9	66	17	17	–
Para	13	0.24	23	36.2	67	–	33	–
Lentil	13	0.23	46	41.2	17	50	33	–
Onion	13	0.16	69	81.4	22	67	11	–
Brinjal	8	0.26	88	96.7	29	57	14	–
All crops	100	NA	100	69.6	NA	NA	NA	NA

-None or not available NA. Not applicable
Source: Field survey

A substantial proportion of the users applied only Urea and only 13-36 percent of users in major crops applied recommended rates. The average rates of application for users were quite low being 20-47 percent of the recommended rates (Table 2).

Rate and mix of fertilizer use improved with increase in farm size, level of education, experience in fertilizer use and intensity of irrigation (measured by irrigation cost per acre). Part-tenants used more fertilizer on owned land compared to rented land (for details see, Islam 1981).

III

For each crop, non-users were asked the reasons for not applying fertilizer and part-users, that is, those using less than recommended rate or fertilizing part of the crop fields, were also asked the reasons for not using fully. The answers are summarized in Table 3. Most of the respondents mentioned more than one reason so that the causes could not be fully separated. However a vast majority mentioned high price of fertilizer and lack of fund as the major causes and a substantial proportion of respondents in case of jute, wheat and aus mentioned low price of output as the major cause. In reality, high

price of fertilizer is inversely related to the other two causes. For example present price of fertilizer might be high in relation to the present price of output or vice versa. Or, available fund may not permit purchase of necessary amount of fertilizer at the current price, so the price may be considered high in relation to available funds. Thus, taken together they imply that fertilizer use could be increased by regulating any one of these three variables while keeping other two unaffected. For example, at existing prices of fertilizer and output, availability of credit may induce higher rate and better mix of fertilizer application (see, Jabbar 1979 for evidence on this).

Table 2: Amount of Different Fertilizers Applied and Proportion of Recommended Rate Applied in Various Crops

Crop	Seers applied per treated acre			% of recommended rare applied				
	Urea	TSP	MP	Total	Urea	TSP	MP	All types
T.Aman	22	16	7	28*	35	38	22	20
Aus	21	24	10	30	33	57	62	24
Jute	23	21	11	31	55	210	29	46
Wheat	39	28	16	62	37	33	33	26
Boro HYV	56	28	12	91	53	38	29	41
Boro LYV	33	25	9	55	52	60	28	40
Mustard	23	27	20	56	72	43	83	47
Lentil	28	27	15	61	88	43	42	47
Para	20	20	13	23	–	–	–	–
Kaun	26	27	16	40	–	–	–	–
Onion	32	20	11	52	–	–	–	–
Brinjal	44	29	12	67	–	–	–	–

a. Components do not add up to total because the rates are based on treated area.
- Recommended rates of these crops in the area were not available.

Source: Field survey

As mentioned in section I, price of fertilizer is the main focus of this note. Therefore, those giving high price of fertilizer as a cause were asked for each crop separately, at what price they would use the recommended rate of fertilizer to that crop. The suggested price of a fertilizer for a specific crop did not differ much among the respondents, so the averages of the suggested prices are shown in Table 4.

It appears that part users were more price sensitive in that they suggested a slightly larger reduction in prices compared to non-users. This seems to be rational because marginal productivity of fertilizer for non-users is expected to be higher than that for users so that a larger reduction in price might be necessary to induce users to apply more fertilizer.

Table 3: Causes for Not Using Fertilizer/Fertilizing Partially in Some Crops

Crop	% of the producers involved	CAUSES					
		High price of fertilizer	Low price of crop	Lack of fund	High fertile land	Not available in time	To see the response with out fertilizer
% of non-users reporting							
Aus	14	69	–	77	8	–	–
Jute	37	70	78	65	9	–	–
Wheat	4	100	33	67	33	–	–
Boro LYV	24	25	–	25	15	25	33
Mustard	28	73	–	64	18	27	–
All crops	21	69	35	65	15	6	2
% of partial users reporting							
Aus	19	77	31	69	8	23	–
Jute	18	100	71	100	29	43	–
Boro LYV	19	67	–	100	33	–	–
All crops	19	76	36	76	16	24	–

Source: Field survey

IV

The suggested prices at which farmers would use recommended rates represent a kind of expectation. It does not imply that recommended rates would be actually used if prices were reduced to the suggested levels. However, difference between current and expected prices of fertilizer and that between current and recommended rates of fertilizer application being quite substantial, it may be assumed that rate of fertilizer application is responsive to its price. To measure the degree of responsiveness, elasticity of demand for a specific fertilizer (j) with respect to a crop (i) could be estimated thus:

$$e = \frac{\Delta Q}{Q} \Big/ \frac{\Delta P}{P}$$

Where: e= price elasticity of demand for fertilizer j in crop i

ΔQ= recommended rate of fertilizer for crop i – current rate of application in crop i

Q= current rate of application in crop i

P= current price of fertilizer j

ΔP= current price – suggested price at which recommended rate of fertilizer would be applied in crop i.

The estimated elasticity might be interpreted as the percentage change in quantity demanded due to one percent change in price.

Table 4: Suggested Prices of Fertilizers at Current Prices of Output at which Farmers would use Additional Fertilizers

Crops	Suggested prices of fertilizers			Suggested prices as percentage of current prices		
	Urea	TSP	MP	Urea	TSP	MP
a. Prices at which non-user would apply fertilizer						
Aus	41	28	21	46	39	29
Jute	48	33	23	53	47	38
Wheat	40	30	20	44	43	33
Boro LYV	45	30	20	50	43	33
b. Prices at which part-user would fertilize total land						
Aus	38	26	17	42	37	28
Jute	40	29	20	44	41	33
Boro HYV	47	28	17	52	40	28
c. Price at which inadequate user would apply recommended rate						
Aus	42	30	20	47	42	33
Jute	39	26	19	43	37	31
Wheat	45	32	22	50	46	37
Boro HYV	46	31	20	51	44	33
Boro LYV	38	27	15	42	39	25

Note: Current prices of Urea, TSP, and MP were Taka 90, Taka 79 and Taka 60 respectively.

The estimated elasticities for major crops are shown in Table 5. It appears that the estimated elasticities are higher for TSP and MP compared to Urea in all crops and most of the elasticities are unusually high. The elasticity for Urea is lower because the current rate of application of Urea is much higher than that of TSP and MP. The estimates are in general very high, i.e. have some upward bias because of two reasons. First, the suggested prices probably have some down-ward bias in the sense that farmers

might have expected a larger reduction in price of fertilizer than they really needed to earn a certain level of profit. Second, non-users and inadequate users of fertilizers have been combined for estimating elasticity. Consequently, current rate of fertilizer application came down making the estimated elasticity high. In reality, the elasticity for a non-user is infinite while it is zero for one using the recommended rate.

Given the above limitations, the estimated elasticities may not be taken for their face values but simply an indication that price of fertilizer is an important factor affecting its use.

Table 5: Estimated Price Elasticities of Demand for Fertilizer by Crop

Crop	Fertilizer		
	Urea	TSP	MP
Aus	4.0	10.4	4.5
Jute	1.2	3.7	6.3
Wheat	4.3	6.8	6.0
Boro LYV	2.5	–	3.4
Boro HYV (IR-8)	0.6	0.4	9.4
Boro HYV (BR-3)	2.3	0.3	8.1

Source: Field survey.

The above findings cast doubt on the arguments that recent increases in fertilizer prices did not affect its demand. Overall demand with low rate of use probably was not affected but increased price probably retarded the possibility of increased rate of application.

Given the estimated price elasticities, is it feasible and desirable to reduce prices to the extent suggested by the farmers ? The following questions need to be examined for answering this question:

1. What will be the additional output or income if prices are reduced to the suggested levels?
2. What will be the additional amount of subsidy at suggested prices?

Tables 6 and 7 show marginal productivity of fertilizer, net additional income and additional subsidy to be given per acre of major crops if prices are reduced to the level suggested by farmers and if recommended rates are used. In estimating marginal productivity, potential yields at recommended rates derived from on-farm trial results conducted in the study area by the Bangladesh Agricultural Research Institute have been used. Yields obtained in these trials were quite lower than those obtained in experimental plots at research stations, so these yields might be assumed to be reasonable. In estimating net additional income due to increased fertilizer use, only the cost of fertilizer

has been deducted from additional output assuming that other costs will not be affected much. Net income estimated by discounting potential output at different rates is also shown. The difference between current price and suggested price has been defined as additional subsidy.

Results shown in Table 7 indicate that fertilizer prices can be reduced to the extent suggested by the farmers. The main constraint in this case might be the ability of the government exchequer to bear this burden. The other main constraint may be supply of fertilizers. Local production and import may have to be increased substantially to meet the increased demand due to decreased price.

The other argument given against price reduction is that large farmers enjoy most of the subsidy because they use more fertilizer. In a situation of in egalitarian land holding, benefit of any subsidy on production input is likely to be unequally distributed. Therefore while fixing price and subsidy, the point to be considered is whether the large number of small farmers have the ability to purchase adequate amount of the input and enjoy benefit of the subsidy along with larger benefit going to the larger farms. The current application rate of smaller farms indicates that the current fertilizer prices are prohibitive for them.

Given both resource and supply constraints on the one hand and potential benefits on the other the question of reducing price by some percentage, if not to the full extent suggested, may be considered because the results indicate that any increase in subsidy is likely to be productive for the farmers, hence for the society as well.

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Table 6: Marginal Productivity of Fertilizer by Crop

Crop	Average yield at recommended rate at trial farms (mds/acre)	Current yield on sample farms (mds/acre)	Yield difference (ΔY)	Fertilizer			ΔY/ ΔX
				Recommended rate (mds/acre)	Current use rate (mds/ acre)	Difference ΔX	
Aus	25.5	19.2	6.3	3.00	0.70	2.30	2.50
Jute	23.9	15.5	8.4	1.70	0.72	0.98	8.56
Wheat	37.0	21.5	15.5	5.92	1.70	4.22	3.67
Boro HYV (BR-3)	59.4	48.0	11.4	5.00	2.40	2.60	4.38
Boro LYV	30.0	20.5	9.5	3.42	1.92	1.50	6.33

Source: Field survey.

Table7: Additional Net Income and Associated Amount of Subsidy on Fertilizer per Acre on Various Crops

Crop	Per acre additional subsidy required to induce use of recommended rate of fertilizer (Taka)	Additional net income derived from using recommended rate of fertilizer (Taka)		
		a	b	c
Aus	133.6	573.90	206.90	d
Jute	75.7	562.70	325.10	109.30
Wheat	243.5	1490.80	896.90	501.30
Boro HYV (BR-3)	211.8	1163.70	246.00	d
Boro LYV	163.0	944.30	516.80	231.80

a. Assuming potential yield i.e. yield at trial farms.
b. Assuming 15 percent less than potential yield.
c. Assuming 25 percent less than potential yield.
d. Negative.

Source: Field survey.