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Farmers' Response to Rise in Fertiliser Prices: Short-Term versus Long-Term Perspectives

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I

INTRODUCTION

The policy for restructuring fertiliser prices in India was to induce faster growth of farm production along with a lower cost of fertiliser subsidy. The new price formula, adopted first in August 1991, was guided by the notion that at the macro level, price elasticity of demand for fertiliser is low (Parikh and Suryanarayana, 1990); it was assumed that if fertiliser prices increase by 50 per cent, the amount needed to eliminate subsidies, foodgrains production will fall by about 10 per cent. This fall in foodgrains output could be effectively arrested by increase in output prices (Bhide and Gulati, 1992). While the initial response during 1991-92 more or less confirmed the expected behaviour (Deshpande *et al.*, 1992; Bhide and Gulati, 1992),[1] experiences during the subsequent two years have been quite different. Evidently in spite of substantial rise in output prices, fertiliser consumption has shown a net decline from the level of pre-price control period and more importantly, the nutrient use has become highly imbalanced (FAI, 1994).

It is plausible that these reactions are mainly manifestations of an immediate response to the sudden and substantial increase in the prices of phosphatic and potassic fertilisers. Hence, it could be expected that fertiliser use pattern will again get back to a desired growth path as the relevant information starts flowing to the farmers. However, arriving at a new equilibrium is difficult especially in the light of (a) the continued disparity and uncertainty on the price front (Desai and Rastogi, 1993), and (b) the fact that farmers' decisions in response to input price changes do come albeit with a time lag. Therefore, facilitating the farmers' decision-making process becomes pertinent if the long run adverse implications of the distorted nutrient use (Saxena, 1994) have to be minimised. The relevant issues in the context of fertiliser price rise are:

(i) What are the economic implications of reducing fertiliser consumption? Which major factors influence the farmers' income under the changed price environment?
(ii) Whether the farmers understand these implications? To what extent their fertiliser use decisions are guided by economic implications?
(iii) What kind of extension support would be needed to help the farmers taking decisions that would maximise their net returns?

An attempt has been made to address these issues through a small survey of farmers carried out during the last quarter of 1991 in the irrigated as well as dry farming areas of Gujarat (Sah and Shah, 1993). The survey covered a sample of 297 farmers growing six major crops, i.e., cotton, castor, wheat, mustard, paddy and groundnut. This paper highlights some of the important findings of the study. It may be mentioned that although the survey

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could capture only the initial phase of fertiliser price rise, the findings are still relevant. For, the major strength of the study lies in demonstrating as to how a holistic approach to understand the farmers' response behaviour can help in improving their decision-making process.

The analysis here is mainly based on calculations of net returns along with simulations of net returns considering alternative yields and prices. The farmers' first reaction to rise in fertiliser prices was obtained by asking him at what level he would use fertilisers in changed price situation. We know the limitations of this approach; first, the full impact of fertiliser price rise has a time lag; and secondly, it is difficult to isolate the impact of fertiliser price rise from other forces which shall simultaneously be influencing the demand for fertilisers. In order to isolate the effect of these factors we put the condition that all other factors except output price have to be kept at the pre-price rise levels. The farmer was also asked to give the expected level of yield with changed fertiliser use. We then worked out the estimates of change in net returns for pre- and post-price rise situations. Using these estimates, a direct question was asked to the farmer whether he would like to revise his first reaction? The farmer's responses in terms of the proposed level was compared with his reduced level of use to identify whether he wants to continue the use of fertilisers at their first reaction level or wants to increase its use in order to increase his returns. This is termed as his second reaction. In order to ascertain the association between the farmers' decision to revise their fertiliser use and certain explanatory variables. Analysis of Variance (ANOVA) and Multiple Classification Analysis (MCA) have been used.[2]

II

THE FRAMEWORK

Demand for fertiliser is a derived demand which is influenced, among other things, by (a) the yield response of fertilisers, (b) fertiliser prices, and (c) price of the agricultural products. Changes in any one of the above three would affect the demand for fertilisers. But at the time of sowing when the farmers apply the first dose of fertiliser, they are not certain about yield response and the output prices. The farmers' expectations about these two variables are likely to be influenced by their recent experiences. Therefore, the effect of changes in the prices of fertiliser on its demand will depend on the farmer's perceptions about the size and certainty of yield response to added fertilisers, and his expectation about prices of output. If expected net returns even after rise in prices are attractive, the farmer may demand the same quantity of fertiliser. But if the expected net returns from fertiliser use are low, the use of fertilisers may decline.

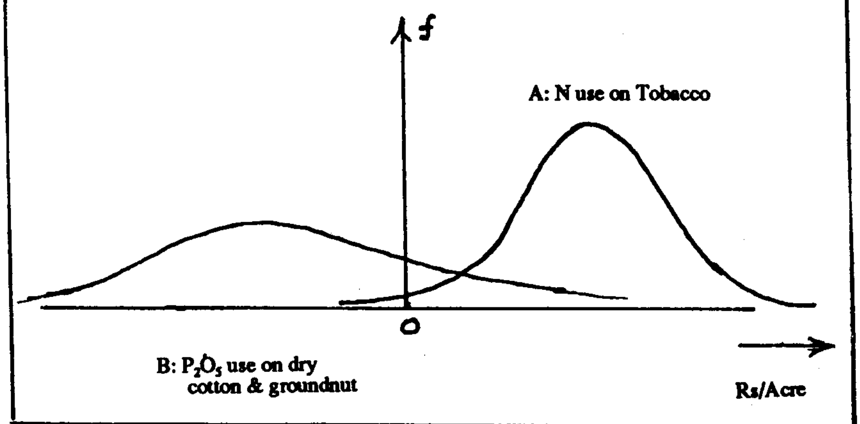
Estimating price elasticity may not be appropriate for evaluating the farmers' response to price rise, for the farmers respond to changes in net returns owing to simultaneous changes in both input and output prices. Therefore, in order to capture the farmers' response, the following situations may also be considered. First, fertiliser is not the only input which constitutes marginal cost, hence the impact of rise in its prices on net returns would be varying under the changing cost of complementary inputs. Second, there has been a simultaneous rise in the prices of agricultural output; consequently, the economic loss due to higher cost may be compensated by rise in output prices. And third, many farmers are likely to be operating at levels lower than the optimum where marginal net revenue is substantial enough for an increase in fertiliser use even after price rise. This situation may arise particularly due to financial constraints or information gap. Given this reality, it is plausible that reduction in fertiliser use, due to rise in its prices, will lead to relatively greater loss in net revenue compared to the situation where fertiliser use did not decline.

In fact, the farmers' response to increase in fertiliser prices will not be the same across situations; it shall vary according to (a) the levels of fertiliser use, (b) access to assured irrigation hence yield response environment, and (c) changes in the cost of complementary inputs and output prices. Together, these factors will influence the level of marginal net returns against the incremental cost of fertilisers. For instance, farmers operating with medium levels of fertiliser use on an irrigated crop with simultaneous positive movement in output prices may not reduce fertiliser use because at the margin net financial returns on fertiliser use would be quite substantial (irrigated HB castor). Compared to this, farmers growing crops with uncertain returns may not have so much incentive to incur the additional cost of fertiliser because of high risk (irrigated HB cotton). On the other hand, farmers operating under unirrigated conditions may still not reduce fertiliser use under a crop situation where the required dose of fertiliser is low or where fertiliser is not a major component of the total cost (dry groundnut). Compared to this, crops facing high degree of weather-induced uncertainty in yield and also requiring higher doses of fertilisers may face a significant decline in fertiliser consumption (dry maize and bajra). Farmers growing crops (canal irrigated paddy, sugarcane, banana) where complementary input cost has not changed significantly, may not react negatively to rise in fertiliser prices and may continue the same high level of use to maximise returns. On the other hand, farmers located in regions with deep groundwater table may reduce fertiliser consumption (irrigated wheat, mustard, and HB cotton) because of higher cost of irrigation. In all the above cases, the negative response to rise in fertiliser prices could well be in the form of shifting from high grade high cost diammonium phosphate (DAP) to low grade NPK mixtures or to urea.

The findings emanating using this frame need to be interpreted with caution, for those who believe in *positivism* would find hard to put faith on unwarranted farmers' *perception*. We would like to justify here why such *perceptions* are not unwarranted. Let us start from the beginning, the fertiliser use recommendation. With respect to fertiliser use recommendation there is not '*a*' reality; there are only perceptions of a reality, may it be at research station, at the extension agents' level or at the farmers' level. Those who are living in 'Newtonian' deterministic paradigm only live in a paradise of '*a*' recommendation. When a large number of experiments conducted over time and space are analysed, the findings at the best would be hypothesised as (a) there exists a level of fertiliser use at which the yield response is *significantly different* than the other levels; and (b) at this so-called recommended level of use, probability distribution of yield may be of a type which is highly certain of providing optimum returns. The distribution is depicted in Figure 1(A) which represents the case of tobacco in Gujarat (Patel *et al.*, 1985). Or may be of a type representing high uncertainty of providing even a positive return. The distribution is depicted in Figure 1(B) which represents the case of dry cotton and groundnut in Gujarat (Gujarat Agricultural University, 1986; Modhwadia, 1988).

Let us analyse Figure 1(B) more closely. The scientists at the Agricultural University are aware that by their analysis phosphate should not be used at recommended rates on cotton and groundnut in the dry zone because the probability of obtaining even positive returns is very low. In fact, phosphate should not be used at all on these crops for there is no level of phosphate use at which the yield is 'significantly different' than zero level of use. This is the perception at the research station.

Figure 1: Probability Distribution of Net Returns at Recommended Levels of Fertiliser Use



By the time these recommendations move to Department of Agriculture, the pressures from industry and the body polity mount to revise these recommendations. And hence, *in order to avoid the long-term depletion of soil phosphate,* the Department recommends *a* level of phosphate for these two crops. This is the perception at the level of extension agent.

At the farmers' level in dry farming areas of Gujarat only one perception persists, namely, DAP must be applied to groundnut and cotton in order to 'maximise' yields in a normal year, a year which may come only twice in a weather cycle of ten years. And this they do year after year irrespective of the weather conditions and much before the onset of the monsoon. This is done irrespective of the fact that on that plot they may eventually grow cereals or the plot remains unutilised because of drought. But the basic fact remains that if it turns out to be a normal year, the crop should not suffer because of any of their cultural practices, including fertiliser use.

The three important players in the fertiliser business have different perceptions of *a* reality. Are they wrong? Yes and No; Yes if one looks from others' perspective; no when one looks from one's own perspective. We can not ignore these variations. This study tries to capture the farmers' perceptions.

III

FARMERS' FIRST REACTION TO PRICE RISE

Using the above framework, the following analysis tries to ascertain the farmers' response to the rise in prices of fertilisers across different typologies of crops-irrigation-fertiliser use levels in Gujarat.

The farmers' initial reaction in terms of change in demand for fertilisers was obtained by comparing the actual fertiliser use before the price rise with the intended level of use after the price rise. For *rabi* crops the comparison was between the actual use in *rabi* 1990-91 and the proposed use in *rabi* 1991-92. For *kharif* crops, where fertiliser was already purchased before the price rise, estimates were obtained by asking what would have been the level of fertiliser use if prices had increased before the beginning of *kharif* cultivation? Thus, if the proposed (in the case of *rabi* crops) or the intended (in the case of *kharif* crops) level of use after the price rise was found lower, same or higher compared to pre-price rise levels, the reaction was treated as 'reduced', 'keeping same' and 'increased' fertiliser use respectively.

Initial Impact on Fertiliser Use

Only 23 per cent of the farmers reacted negatively to the increased prices and reported reduction from their pre-price rise level of fertiliser use. The overwhelming trend, covering 70 per cent of the farmers, was 'no impact on the level of fertiliser use'. The remaining 7 per cent of the farmers reported increase in the level of use (Table I). The pattern of first reaction across crops and districts brought out three important features. First, the incidence of reduced fertiliser use is quite low among the farmers growing canal irrigated paddy in Valsad and among farmers growing low irrigation requiring crops like castor in Sabarkantha. This is so, in spite of the high fertiliser use in these crops. The underlying rationale was that given the simultaneous changes in input-output prices, the present levels of yield would still give the expected net returns. Second, the yield aspect was all the more crucial even in the highly uncertain environment of groundnut cultivation in Bhavnagar. These farmers, despite a severe crop failure during 1990-91 *kharif*, maintained that they would try to attain maximum yield if the weather is favourable. Since weather is not within their control, they do not want to lose on account of low fertiliser use. Only 10 per cent of the groundnut cultivators reported a cut in their fertiliser use because of the price rise. Third, unlike groundnut growers, the reaction among wheat and mustard growers using groundwater in Mehsana, hence operating under a relatively certain response environment during the *rabi* season, was quite negative. Nearly 40 per cent of these farmers reported that they would reduce their fertiliser use irrespective of the adverse implications on yield and net returns. Apparently their attitude could be an outcome of the politically sensitive situation in the region. More on it in subsequent sections.

TABLE I. FIRST REACTION OF FARMERS IN RESPONSE TO INCREASE IN FERTILISER PRICES

District and crop	Change in fertiliser use			
	Decrease	Same	Increase	All
(1)	(2)	(3)	(4)	(5)
		Percentage[a]		
Sabarkantha	20	74	6	100 (80)
Cotton	23	73	5	100 (40)
Castor	18	75	8	100 (40)
Mehsana	39	49	12	100 (100)
Wheat	37	55	8	100 (60)
Mustard	43	40	18	100 (40)
Valsad				
Paddy	16	83	1	100 (58)
Bhavnagar				
Groundnut	10	86	3	100 (59)
All	23 (70)	70 (206)	20 (7)	100 (297)

Source: Derived from Sah and Shah (1993).
a. Percentage of sample farmers in each district/crop.
Figures in parentheses indicate number of farmers.

Crop Economics under Changing Price Situation

Table II presents the relative picture of the average net revenue accruing to the farmers before and after the rise in fertiliser prices. The estimates are based on the reported changes in fertiliser use, input-output prices and yield among those sample farmers who reduced their fertiliser use. The underlying assumption is that, other things remaining the same, the difference in net revenues between two points of time is influenced by changes in (a) yield due to reduced fertiliser use and (b) prices of fertiliser as well as crop. The pattern reveals that changes in net revenue is different across crops. The net returns have declined by more than 10 per cent in the case of cotton and paddy; it has marginally declined in the case of wheat and mustard; whereas net returns have increased in the case of groundnut and castor. However, the major source of decline in the net revenue is fall in yield due to reduction in fertiliser use rather than due to rise in the cost of fertilisers (Table III).

TABLE II. CHANGE IN CROP ECONOMICS DUE TO INCREASED PRICES OF FERTILISER

Crops	Rise in total cost due to 30 per cent increase in fertiliser prices[a]	Change in		
		Fertiliser use	Yield	Net returns[b]
(1)	(2)	(3)	(4)	(5)
			Percentage	
Cotton	6	-39	-27	-21
Wheat	9	-38	-11	-2
Mustard	8	-56	-21	-10
Groundnut	7	-48	+22[c]	NE
Paddy	11	-36	-10	-14
Castor	4	-42	-19	-21

Source: As in Table I.
a. Refers to total cost in the initial year before reducing the level of fertiliser use.
b. At reduced level of fertiliser use and yield but with new prices of fertiliser and output.
c. Due to crop failure in Saurashtra yield in the initial year was lower.
NE = Not estimated.

TABLE III. RELATIVE IMPACT OF FACTORS CONTRIBUTING TO NET RETURN

(Rs./ha)

Crops	Additional cost of fertiliser (at old level of use)	Loss of net returns[a] due to yield (if output price did not change)	Additional net returns[b] due to output prices (at old level of yield)
(1)	(2)	(3)	(4)
Cotton	586	4,236	3,982
Wheat	388	1,089	1,112
Mustard	419	2,405	2,028
Groundnut	96	NE	775
Paddy	428	989	2,047
Castor	362	2,772	952

Source: As in Table I.
a. Indicates difference between the net returns in the pre-price rise period (NR1) and the post-price rise period net returns (NR*), where
NR1 = y1p1 - (fc1 + c)
NR* = y2p1 - (fc2 + c)
y1 = yield of period 1,
p1 = output price of period 1,
fc1 = cost of fertiliser in period 1,
c = cost of other inputs,
y2 = yield of period 2,
fc2 = cost of fertiliser in period 2.
b. Indicates difference between NR1 and net returns NR** assuming old yield (Y1), and changed price environment of period 2, where
NR** = y1 p2 - (fc2 + c)
p2 = output price of period 2.
NE = Not estimated.

The pattern is consistently observed across all the crops. It is demonstrated that the additional expenditure on fertiliser ranged approximately between Rs. 100 and Rs. 600 per hectare. Against this, the loss due to reduction in fertiliser consumption, without accounting for the rise in output prices, worked out to be approximately between Rs. 1,000 and Rs. 4,000 per hectare. If the impact of output prices is included, then the potential loss becomes almost double (Table III). Moreover, using a more unfavourable ratio of input-output prices had indicated that economic viability can be sustained by a high level of productivity rather than by reducing fertiliser use.

Thus the relative magnitude of loss of net returns due to increased fertiliser prices vis-a-vis fall in yield suggests that the farmers, who had indicated a reduction in fertiliser use as their first reaction to price rise, may not have been guided by profit maximising behaviour. If these farmers had maintained the pre-price rise level of fertiliser use, their net revenue would have improved; the reduced fertiliser use, in the case of these farmers, has led to a net decline in income.

Table IV gives the details of 192 farmers who had responded to the calculations of net returns in pre- and post-price rise situations. This includes 61 out of 70 farmers having reduced their fertiliser use, besides 119 who did not change their use and another 12 farmers who increased their use. Evidently, more than 80 per cent of the farmers with reduced fertiliser use had obtained lower yield. For a majority of the farmers in this category, net returns had also reduced. Contrary to this, as large as 70 per cent of the farmers who maintained the same level of fertiliser use, had received higher net returns. Of course, there are instances where yield as well as net returns had declined in spite of fertiliser use remaining the same or higher. Such cases, however, are limited. Hence, it reinstates the above observation that to a large extent loss of yield or net returns is mainly attributable to reduction in fertiliser use rather than to the other factors which are adversely influencing the operating environment.

TABLE IV. CHANGES IN FERTILISER USE, YIELD AND NET RETURNS

Yield/Net returns	Fertiliser use			
	Increase	Decrease	Same	All
(1)	(2)	(3)	(4)	(5)
	Percentage*			
Yield				
Increase	58	10	31	25
Decrease	34	84	23	43
Same	8	6	46	32
All	100	100	100	100
Net returns				
Increase	58	35	70	58
Decrease	25	52	19	30
Same	17	13	11	12
All	100	100	100	100
Number of farmers	12	61	119	192

Source: As in Table I.
* Percentage of the farmers in the fertiliser use category.

Together, the above evidences suggest that productivity is the crucial factor contributing to the returns. Since price movements are relatively more uncertain and also beyond the control of the individual farmer, a better strategy is to maintain yield, rather than to cut down on input expenditure.

Forces Affecting the First Reaction

An important question is whether farmers' decision to reduce fertiliser use is associated with factors like level of fertiliser use, expected output prices, output prices at the time of sowing, expected yield, size of farm, etc. This has been examined by using analysis of variance and multiple classification analysis.

The findings of these analyses (Appendix) reveal that at the aggregate level, the farmers' fertiliser use decisions were not significantly influenced by any of the explanatory variables.[3] Overall, these variables are able to explain only 3 per cent of the variations in the farmers' decisions to change their fertiliser use. Since the explanatory power of the model is statistically insignificant, it leads to an indication that none of the economic variables considered in the analysis was responsible for explaining the farmers' first reactions in any of the crops. Of course, it is possible that other economic factors like resource crunch might have compelled these farmers to reduce the level of fertiliser use; or that there are problems of specification of the explanatory variables. Nevertheless, the fact remains that these farmers had failed to recognise the potential loss in net returns especially resulting from the expected loss of yields. Contrary to this, a large number of farmers who did not reduce the fertiliser use were mainly influenced by the yield considerations rather than by the increased output prices (Sah and Shah, 1993). Together, these evidences indicate that the farmers' decision of reducing the fertiliser use was an outcome of either an inadequate understanding of fertiliser-yield response environment or a psychological reaction to a sudden and steep rise in fertiliser prices which came after a long time. And therefore, their negative reaction is likely to be changed when the farmers get a clear understanding about the implications of reduced fertiliser use on their net returns.

It would also be worth understanding whether the farmers are prepared to change their earlier decision if negative implications on net returns were discussed with them. If so, which are the important factors bringing the change in farmers' decisions? The subsequent analysis presents these findings.

IV

EFFECTS OF EXTENSION: FARMERS' SECOND REACTION

After working out the estimates of change in net returns between pre- and post-price rise situations, we discussed with the farmers the likely loss in net returns if they continue to adhere to their first reaction of reduction in fertiliser use. This was discussed with only 192 farmers including 135 farmers who did not reduce their fertiliser use. For those who did not report reduction in fertiliser use, the focus was on additional gains in net returns resulting due to increased output prices. We then asked all the farmers, including the 192 farmers for whom the estimates of changes in net revenue are available, whether they would increase their fertiliser consumption if expected yields and output prices remained as they were. In this discussion it was assumed that other input use has remained unchanged. One may question the *ceterus paribus* assumption with which these conclusions have been drawn. They, nevertheless, may be justified in the light of the fact that (a) the weather-induced uncertainties in yield would be much less on irrigated crops which excludes groundnut; (b) notwithstanding these uncertainties, the farmers' input use decisions are often taken in advance by discounting the risk factors; and (c) these decisions have remained fairly stable year after year (Sah and Shah, 1995). It would, therefore, not be unrealistic to attribute reduction in yield to reduced fertiliser use (as seen in Table IV). In any case, the assumptions behind these calculations were discussed with the farmers before arriving at the final estimates. Moreover, these estimates were used more as indicative of directional change rather than as exact magnitudes. The farmers' response in terms of the proposed level was compared with their first reaction level of use. If the proposed level of use was higher, it was considered that the decision was positively influenced after our discussions.

Table V gives the details about the farmers' second reaction with regard to their proposed level of fertiliser use. It was found that 49 out of the 70 farmers who reduced the fertiliser use were convinced to increase the level of application. This leaves only 7 per cent of the sample farmers (i.e., 21 out of 297) to continue with the decision of reducing the fertiliser use. A large proportion of those farmers who did not change their fertiliser use in the first reaction wanted to remain at the same level. This was so in spite of the incentives in terms of a substantial increase in net returns resulting from increased output prices.

TABLE V. SECOND REACTION ON FERTILISER USE AMONG FARMERS WHO REDUCED THE USE AS FIRST REACTION

Crops	Second reaction					All farmers who reduced the use
	May still not increase	Shall increase				
		Lower than base level	Base level	Higher than base level	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Percentage[a]					
Cotton	(1) 2.5	-	20.0	-	(8) 20.0	(9) 88.8[b]
Wheat	(6) 10.0	1.6	23.3	1.6	(16) 26.5	(22) 72.7
Mustard	(7) 17.5	-	25.0	-	(10) 25.0	(17) 58.8
Groundnut	(2) 3.3	1.7	1.7	3.2	(4) 6.6	(6) 66.6
Paddy	(4) 6.8	1.7	5.1	1.7	(5) 8.5	(9) 55.5
Castor	(1) 2.5	-	12.5	2.5	(6) 15.0	(7) 85.7
All crops	(21) 7.0	1.0	13.8	1.6	(49) 16.4	(70) 70.0

Source: As in Table I.
a. Percentage of the total number of farmers surveyed for each crop.
b. Farmers who 'shall increase' as percentage to those whose first reaction was reduction in fertiliser use.
Figures in parentheses indicate the number of farmers in the respective categories.

In order to identify the factors which have significantly influenced the farmers to change their first reaction, we have used ANOVA and MCA methods in two iterations. Iteration I, using all the respondents, analyses five explanatory variables for explaining the farmers' second reactions. Iteration II includes change in net returns as an additional explanatory variable. This was done using 192 farmers for whom the data on net returns are available. The findings of the analysis are presented in Table VI.

TABLE VI. FACTORS INFLUENCING FARMER'S DECISION TO INCREASE FERTILISER USE AFTER CHANGE IN NET RETURNS

Crops	Factors							
	Change in returns	Change in NPK use	Base yield	Base price	Base fertiliser	Size-class	N	R^2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Iteration I				
All crops							295	0.40***
F		79.2***	NS	NS	5.73***	6.21***		
β		0.6			0.16	0.17		
Group willing to increase NPK		Reduced NPK			Low base	Medium		
Cotton							40	0.68***
F		31.23***	-	-	NS	NS		
β		0.80						
Group willing to increase NPK		Reduced NPK						
Wheat							60	0.55***
F		29.13***	-	-	-	NS		
β		0.71						
Group willing to increase NPK		Reduced NPK						
Mustard							40	0.72***
F		27.84***	2.84*	4.78*	-	11.92***		
β		0.73	0.23	0.34		0.50		
Group willing to increase NPK		Reduced NPK	Low	Low		Medium		
Groundnut							59	0.32***
F		1.9	-	4.87***	-	5.12***		
β		0.23		0.37		0.38		
Group willing to increase NPK			NS	Low price		Medium		
Paddy							58	0.37**
F		5.17***	-	-	-	2.57*		
β		0.6				0.24		
Group willing to increase NPK		Reduced NPK				Medium		
Castor							39	0.38**
F		7.03***	-	2.57**	-	NS		
β		0.54		0.33				
Group willing to increase NPK		Reduced NPK		High price				
				Iteration II				
All crops							192	0.44***
F	7.12**	43.10***	-	-	2.33*	4.84**		
β	0.22	0.55			0.12	0.16		
Group willing to increase NPK	Reduced NR	Reduced NPK			Low base	Medium		

Source: As in Table I.

Notes: The dependent variable is change in fertiliser use after the discussion on the economic implications of reduced fertiliser use. The variable takes value 0 if the farmer is not willing to increase the use; and 1 if willing to increase.

Apart from the six variables, the two other independent variables are (i) change in fertiliser use as first reaction and (ii) change in net returns due to change in fertiliser use as first reaction.

NS = Not significant. ***, ** and * = Significant at 1, 5 and 10 per cent level respectively.

Crop specific analysis was not done for iteration II because of small number of observations.

Three out of five independent variables considered in the analysis had significant impact on changing the initial decisions when all crops were taken together. The three factors are: (a) reduced fertiliser use; (b) low level of base fertiliser use; and (c) farm size. Together, they explained 40 per cent of the variation in the farmers' second reaction. For individual crops, the pattern was somewhat different. For mustard, groundnut and castor base year output price was found to be more important besides reduced fertiliser use. The results of iteration II were found to be quite consistent with that in iteration I; apart from the three factors identified in the first model, reduction in net returns was also found to have significant impact on the farmers' decision. In terms of relative importance, reduced net returns stood next only to reduced use of fertiliser as indicated by the β value. This analysis suggests that the probability of increasing the fertiliser use was much higher among those farmers (a) whose net returns had declined as compared to the remaining farmers whose net returns had increased or remained the same, (b) whose base level fertiliser use was low, and (c) who have received low output prices during the base year.

The above analysis brings home two important findings. Firstly, with relevant information, the farmers can be motivated to change their immediate reaction of reducing fertiliser use. And secondly, the farmers' second reaction is tuned according to the nature of economic incentives. If the perceived incentives to increase fertiliser use are higher, the farmers' decisions can be changed. On the other hand, if the incentives are relatively low, convincing the farmers is a major challenge for the extension system. Our brief interaction with the farmers during field work demonstrates that the task is not difficult. This optimism is further supported by the fact that in the case of three-fourths of the sample farmers whose first reaction was positive, maintaining the yield is the most important consideration for their decision regarding fertiliser use.

V

EMERGING SCENARIO

The optimism which emerged from the farmers' ability to understand the economic rationality, may, however, be viewed with caution. For, the initial changes in price environment was quite favourable as compared to the complex reality which is rapidly unfolding in Gujarat's agriculture, besides the subsequent distortions in the relative prices of different nutrients. Unless, the implications of some of these equally important developments are properly understood, the optimism may hold little relevance.

The factors, which are likely to adversely affect the farming environment especially in the irrigated tracts of North and South Gujarat, are simultaneous increase in the cost of irrigation, pesticides, labour, high incidence of pest attack on cotton, receding availability of groundwater, waterlogging in the canal irrigated areas of South Gujarat; and market development of relatively new oilseeds, e.g., castor. Together these factors seem to have led to new trends (Sah, 1992) in terms of (a) the shift in cropping pattern in favour of crops requiring less irrigation as well as fertiliser (e.g., from wheat to mustard); (b) reduction in the level of fertiliser use in the crops facing frequent failure (e.g., cotton); and (c) restricted supply of canal water during summer, hence reducing the area under paddy.

The newly emerging trends are likely to bring further decline in fertiliser consumption. This phenomenon was clearly brought out during our discussion with the farmers. For instance, 48 out of 70 farmers, whose first reaction was to reduce fertiliser use, also reported other factors, viz., increased cost of other inputs and availability of water as well as farmyard manure responsible for their decision. Moreover, those whose second reaction was positively influenced reported that they would get back to the base level fertiliser use only if the output prices or farmyard manure use or yield are sustained at the expected level. Similarly, those who were not motivated to increase the use were found apprehensive about the expected increase in output prices or sustainability of the earlier yield levels.

A somewhat similar phenomenon is also observed in the context of the changing cropping pattern. As large as 85 per cent of the sample farmers had changed the cropping pattern during 1991-92 as compared to 1990-91. The major reason for such changes were relative output prices, availability of inputs, especially irrigation, better yield response and fodder requirement. The shift in cropping pattern away from some of the high fertiliser consuming crops like cotton and wheat may also have a dampening impact on fertiliser consumption.[4]

Together, these scattered evidences tend to suggest that, other things remaining the same, fertiliser price rise is not going to bring a decline in its use. However, for a substantially large proportion of farmers the future decision on fertiliser use is uncertain; the use-pattern would depend on factors like (a) sustainability of yield, (b) availability of irrigation, (c) remunerative output prices and (d) extension/information support. Although the farmers adjust their input use through continuous experimentation, the process could be made shorter and smoother with the help of extension support to them. It is imperative that the extension services provide proper signals to the farmers relating to balanced and efficient use of various inputs so as to check haphazard changes in the fertiliser use.

VI

CONCLUSIONS

The findings of this analysis reveal that so far as fertiliser consumption is concerned, the initial increase of about 30 per cent in fertiliser price was almost a non-issue; given the technology and expectations of an increase in output prices, about 70 per cent of the sample farmers believed that they will be able to sustain their present levels of net returns and hence will not like to reduce fertiliser use. Nonetheless, about one-fourth of the farmers scattered all over the survey area reported their first reaction to price rise as reduction in consumption. Moreover, some farmers intended moving away from high nutrient fertilisers towards mixed fertilisers having low nutrients. We noticed that the farmers' attitude changed when the questions of changes in yield and net returns under the changed price environment were discussed with them. After discussing the economics of fertiliser use, 70 per cent of those farmers who earlier reported reduction saw the economic losses they would incur due to their decision to reduce fertiliser use and were willing to increase the use. Only 7 per cent of the sample farmers were unwilling to change their decision to reduce fertiliser use. This suggests that the farmers can be helped to adjust their input use provided relevant information pertaining to fertiliser yield response and its impact on net returns are made available to them.

However, one needs to view with caution the optimism that the farmers' decisions are shaped only by economic considerations: for, the price rise had come at a time when crop economics had to face high cost of inputs like lift irrigation, labour, and pesticides; increasing pest problems; and the credit squeeze. As a result many farmers, especially in the high phosphate using cotton and wheat zone of North Gujarat, had chosen price issue to voice their grievances against, what they consider, *the anti-farmers'* policy of the Government.

Independent of fertiliser price rise, certain other forces like increased input costs, receding water resources and availability of irrigation, frequent crop failures and increased yield risk have made the farming a loss making proposition in Gujarat. This has not only led to change in cropping pattern but has also given signals for a fall in fertiliser consumption at the macro level. Therefore, it calls for accelerating those processes whereby yields continue to increase, irrespective of the uncertainties prevailing in the operating environment. This can be ensured only when the farmers are able to work out the implications of price and non-price factors on net returns under the changing operational environment.

Sah and Shah (1993) have suggested that a substantially large proportion of irrigated farmers in Gujarat have misconceptions regarding yield response to added fertiliser.[5] These perceptions have been shaped in a chaotic environment (Sah and Shah, 1992) where farmers (a) perceive nitrogen to be a close substitute of phosphate; (b) are unable to visualise the effect of changes in nutrient balance on crop growth; and (c) are constrained in adopting efficient farm practices and fertiliser use techniques due to inadequate resources or lack of information. The extension agenda may also include aspects like fertiliser uses and water use efficiency; complimentarity between phosphate and farmyard manure use; use of micro nutrients; better management of other farm practices; and fertiliser use under a crop cycle. Instead of mechanically conveyed messages, what farmers want is effective counselling which takes care of the changing environment. The agenda for technology support may be incomplete if the research and extension network are indifferent to farmers' perceptions about yield response and the economic forces responsible for shaping them.

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NOTES

1. Some of the important observations which emerged from the micro level studies on the impact of increase in fertiliser prices were (a) the negative impact on fertiliser demand is more on *kharif* than on *rabi* crops; and also the impact is relatively higher among the irrigated and agriculturally more developed regions as compared to semi-arid regions (Bhide and Gulati, 1992); and (b) a large number of farmers, including small farmers, growing commercial crops in the less developed regions, did not actually reduce fertiliser consumption (Deshpande *et al.*, 1992).

2. In order to ascertain the relationships between explanatory variables and farmers' fertiliser use behaviour, two analytical tools, namely, Analysis of Variance (ANOVA) and Multiple Classification Analysis (MCA) have been used. Basically, this approach is to ascertain (i) a measure which shows that among different categories of an explanatory variable, there is at least one level at which the incidence of fall in fertiliser use is significantly high; and (ii) relative importance of different explanatory variables in explaining farmers' response to rise in fertiliser prices. The first set of evidences are provided by ANOVA (F test) and the second by MCA (β coefficients).

3. However, at individual crop level, certain factors were found associated with the farmers' decisions to reduce fertiliser use. For instance, those who wanted to reduce fertiliser use on mustard were mainly those who had higher level of fertiliser use during the base year. Similarly in paddy, the farmers reducing fertiliser use belonged to the category of low or high fertiliser use during the base year. In groundnut, the decision to reduce fertiliser use was associated with those who had received low output price during the base year.

4. A rough estimate of the negative impact of such shift in the case of cotton in Sabarkantha district indicated that between 1984-85 and 1987-88, about 40,000 hectares of land was shifted away from cotton. This had brought a decline of about 19,000 tonnes of nutrients used in the district. [*Sources: Districtwise Area, Production and Productivity*, Bureau of Economics and Statistics, Government of Gujarat, Gandhinagar; Government of Gujarat, "Chemical Fertilisers: Distribution Centres, Shares, Dispatches, Distribution and Consumption, 1983-84 to 1987-88", *Margdarsika* 192, Directorate of Agriculture, Gandhinagar, Gujarat; and Fertiliser Statistics, Fertiliser Association of India, New Delhi (various issues)].

5. It was observed that a large number of farmers who did not change their fertiliser use and wanted to continue with the present level for a longer time reported 'maintaining the yield level' as the major consideration for their use-pattern. For most of them the present level was perceived to be the maximum attainable yield.

APPENDIX

FACTORS AFFECTING THE FIRST REACTION TO FERTILISER PRICE RISE AMONG THE SAMPLE FARMERS†

Crops	Factors				R^2	N
	Base yield	Base output price	Base fertiliser use	Expected output price		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
All crops						
F			1.45		0.03	297
β			0.10			
Cotton			NS			
F			1.4	1.94	0.16	40
β			0.27	0.33		
Wheat			NS			
F			1.16			
β			0.2		0.04	60
Mustard			NS			
F		0.85	3.00*		0.18	40
β		0.21	0.40			
Sig. Group reducing fertiliser use		NS	High users			
Groundnut						
F		2.56*	0.63		0.10	59
β		0.28	0.14			
Sig. Group reducing fertiliser use		Low price receivers	NS			
Paddy						
F			3.81**		0.12	58
β			0.35			
Sig. Group reducing fertiliser use			Low and high users			
Castor						
F	1.04		0.43		0.07	40
β	0.28		0.18			
	NS		NS			

NS = Not significant. * and ** Significant at 10 and 5 per cent level respectively.

† Two other independent variables, namely, expected yield and land holding size-class were also used for the analysis.

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