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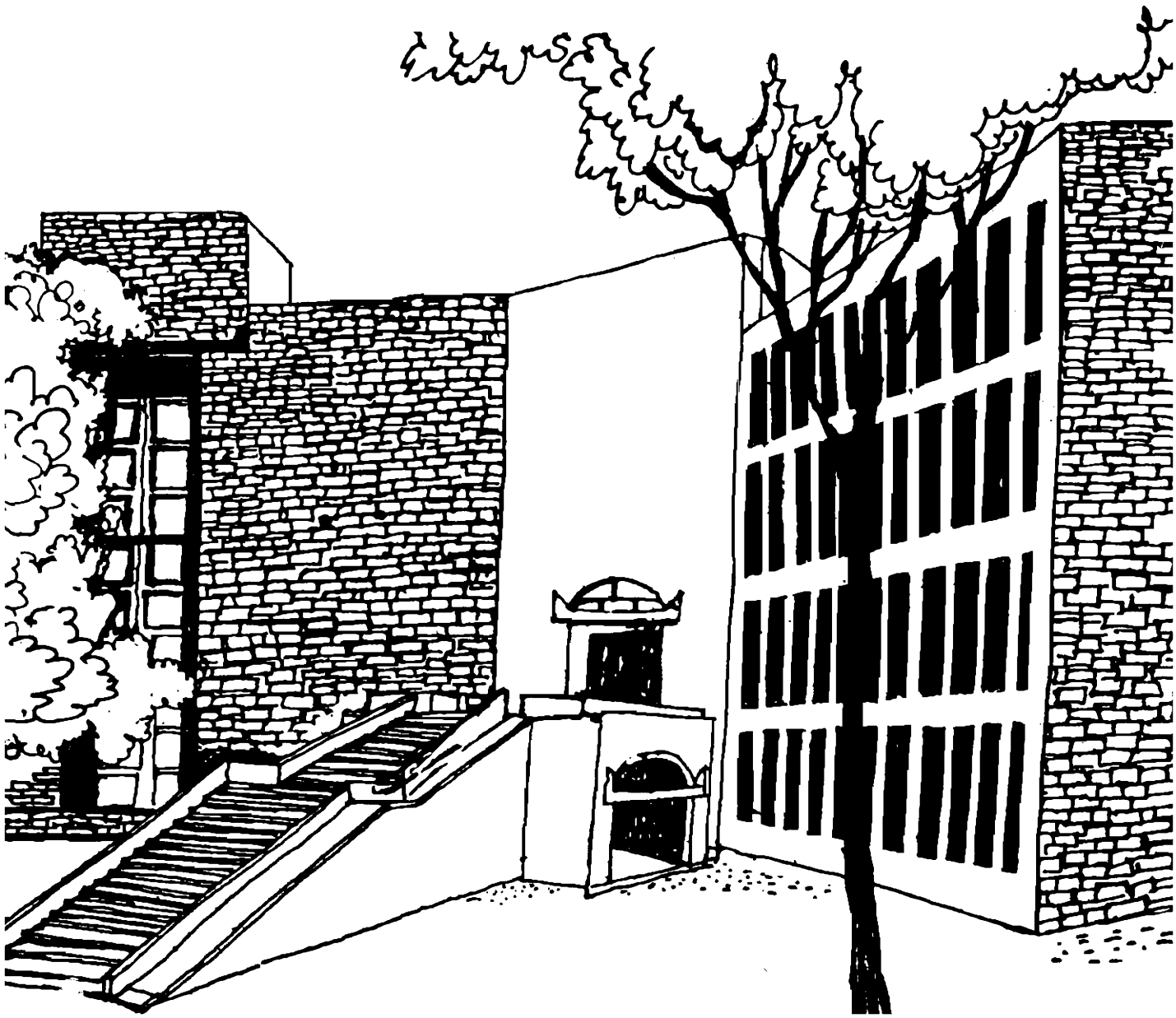

PRICE ELASTICITY OF FERTILIZER DEMAND IN INDIA: A REVIEW

By

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U.K. SRIVASTAVA

ABSTRACT

The government of India has tried to assure a reasonable return to fertilizer industry so that indigenous production can keep pace with the projected increase in demand of fertilizers. At the same time the farmers have also been assured of a reasonable price so that fertilizer use can be encouraged. The Government efforts to meet the twin policy objectives have resulted in a substantial increase in domestic production as well as consumption of fertilizer but at the same time they have also resulted in an increase in subsidy on fertilizers from Rs.604 crores in 1979-80 to Rs.4388 crores in 1990-91.

In the context of reducing budgetary deficit, this increasing level of subsidy on fertilizers has been a matter of concern. In 1991-92 budget, a proposal was made to increase the price of fertilizer by 40 per cent, and this was subsequently reduced to 30 per cent, except in the case of small and marginal farmers where no increase has been envisaged. The impact of 30 per cent increase in the price of fertilizers has a differential impact on the over all cost of cultivation ranging between 0.1 per cent in case of paddy in Assam to highest of 5.25 in case of Wheat in West Bengal, depending on the cropping pattern and level of use of fertilizers.

The concern now is (1) whether the price increase will reduce the absolute level of consumption of fertilizers and / or, (2) whether it will cut down the rate of growth of fertilizer consumption, which is necessary for achieving the food and fiber production ?

This paper is designed to review various estimates of fertilizer price elasticities and their suitability for assessing the impact of price rise of fertilizers on their consumption. Before various estimates are reviewed, the fertilizers use scenario in India is briefly reviewed to provide the backdrop for examining the suitability and acceptability of the estimates of fertilizer price elasticity. At the end of the paper, the areas for further research have been delineated.

PRICE ELASTICITY OF FERTILIZER DEMAND IN INDIA : A REVIEW

U.K.SRIVASTAVA[1]

Introduction

It has been projected that India will require about 240 million tonnes of foodgrains per year by the end of the century. As the scope for the expansion of cultivable area has been exhausted, future increases of agriculture output have to depend on increasing the productivity of land only. It is in this context that the increase in fertilizer consumption is crucial for increasing the productivity.

The government of India has tried to assure a reasonable return to fertilizer industry so that indigenous production can keep pace with the projected increase in demand of fertilizers [8,13]. At the same time the farmers have also been assured of a reasonable price so that fertilizer use can be encouraged [1,9,11,14]. The Government efforts to meet the twin policy objectives have resulted in a substantial increase in domestic production as well as consumption of fertilizer but at the same time they have also resulted in an increase in subsidy on fertilizers from Rs.604 crores in 1979-80 to Rs.4388 crores in 1990-91.

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1. Dr. U.K. Srivastava is Professor in the Centre for Management in Agriculture at the Indian Institute of Management, Ahmedabad. The author would like to express his gratitude to Dr. N.T. Patel and Ms. Madalasa Gandhi of the Institute for their research help in writing this paper.

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In the context of reducing budgetary deficit, this increasing level of subsidy on fertilizers has been a matter of concern. In 1991-92 budget, a proposal was made to increase the price of fertilizer by 40 per cent, and this was subsequently reduced to 30 per cent, except in the case of small and marginal farmers where no increase has been envisaged. The impact of 30 per cent increase in the price of fertilizers has a differential impact on the over all cost of cultivation ranging between 0.1 per cent in case of paddy in Assam to highest of 5.25 in case of Wheat in West Bengal, depending on the cropping pattern and level of use of fertilizers (Table.1).

The concern now is (1) whether the price increase will reduce the absolute level of consumption of fertilizers and / or, (2) whether it will cut down the rate of growth of fertilizer consumption, which is necessary for achieving the food and fiber production ?

The association between fertilizer demand and prices of fertilizers (relative to crop prices) provides the key for answering the above mentioned questions. In the literature, however, there is no consensus about the degree of negative association between fertilizer demand and its prices. In addition, the role of non-price factors, like shortcoming of the distribution system; insufficient credit for both for farmers and distribution agencies; transport bottlenecks; inadequate storage facilities etc., have also been found to play a crucial role in determining the demand for fertilizers [2,3,4,5,6].

This paper is designed to review various estimates of fertilizer price elasticities and their suitability for assessing the impact of price rise of fertilizers on their consumption. Before various estimates are reviewed, the fertilizers use scenario in India is briefly reviewed to provide the backdrop for examining the suitability and acceptability of the estimates of fertilizer price elasticity. At the end of the paper, the areas for further research have been delineated.

Fertilizer Scene in India

The fertilizer consumption during the last 20 years (1969-70 to 1988-89) has consistently and substantially increased from 1.98 million tonnes to 11.04 million tonnes, which indicates a compound rate of growth 3.88 per cent (Table 2). The consumption has, however, been largely concentrated in irrigated crops/areas and some cash crops. The irrigated area has also increased from 36.97 million hectares in 1969-70 to 55.63 million hectares in 1986-87 indicating the compound rate of growth of 1.13 per cent. One of the major contributors to the fertilizer consumption has been the area under HYV. The percentage of HYV to gross cropped area has rapidly increased from 7.03 per cent in 1969-70 to 31.77 per cent in 1986-87. This indicates the compound rate of growth of HYV area to be 3.28 per cent.

The fertilizer prices have been raised only after long intervals and they have been sticky in between, but during the last twenty years (1969-70 to 1988-89) the wholesale price Index of fertilizer have gone up 98 to 288.4 (with the base year 1970-71 = 100), giving a rate of growth 2.70 per cent, It is important

to note, however, that fertilizer price index to foodgrain price index during the period has in fact shown a decline. It has come down from 102.51 in 1969-70 to 73.97 in 1988-89. If one takes fertilizer price Index as percentage of all commodities it has come down from 103.38 in 1969-70 to 66.25 in 1988-89. This indicates that the price of fertilizer relative to crop prices has come down over the years because the wholesale price index of foodgrain and wholesale price index of all commodities has been growing much more rapidly than the wholesale price index of fertilizer. Thus the profitability of fertilizer use has improved over the years.

Even the procurement prices have also been raised substantially, particularly during last ten years. The support prices have increased in 1990-91 over 1980-81 anywhere between 84.0 per cent and 444.4 per cent (Table 3).

As indicated in table 1 earlier, there are, however, vast differences between the States in terms of fertilizers consumption per hectare, HYV coverage of the gross cropped area and percentage irrigated area to gross cropped area (Table 4). These differences indicate that the farmers in various States face vastly different production functions, and even the different points at the same production functions. This raises methodological questions in assessing the impact of fertilizer prices on the consumption of fertilizer in various States, crops and various sizes of farmers. Some estimates have indicated that 70 per cent of the use of fertilizers is by large and medium farmers. Although the small farmers use fertilizers more intensively, the

number using fertilizers is relatively small.

The consumption also remains skewed, towards irrigated crops which emphases the need for increasing the level of consumption in rainfed areas covering 70 per cent of cultivated land and growing important crops like pulses, oilseeds and millets. The skewed pattern of fertilizer consumption is also displayed by the consumption pattern in two seasons namely Kharif (Monsoon) and Rabi (winter). In the year 1988-89 the share of fertilizer consumption in Kharif and Rabi season was in ratio of 47:53. The share of consumption of fertilizer in Rabi is more despite the fact that the cultivated area under Rabi is much less than under Kharif.

It is in this fertilizer use scenario that we have to examine the impact of recent 30 per cent increase in fertilizer prices on its consumption, and overall impact on the rate of growth of agricultural production.

Empirical Estimates of Price Elasticities in India

Only a very few empirical estimates are available for price elasticity of fertilizers. All these are presented in Table 5. In the oldest estimate available by Ashok Parikh [12], His model included only the irrigated area and fertilizer price deflated by farm harvest prices of agricultural commodities. That time the role of HYVs in explaining the fertilizer consumption was not prominent. Most recent estimate by G. Subramaniyan and V.Nirmala [16] has included the ratio of fertilizer prices to agricultural commodities price, percentage of area planted to HYV, per cent of area irrigated, weather condition, measure of land

intensity and trend variable as the explanatory variables of fertilizer consumption per hectare. The empirical equation based on this specification is also good, and the estimated price elasticity (specified as ratio of price of fertilizer to agricultural commodity price) works out to be -.4263, it means that if this ratio changes by one point the consumption per hectare goes down by .4263 Kg. If one looks at earlier data used by Parikh the 1 point change in the ratio (ratio of price of nitrogen to farm harvest price x 100) brings about decline in fertilizer consumption of .2410 tonnes. Using the model of Grilliches [7] developed U S agriculture, Timmer estimated the short term price elasticity ranging between -0.31 to -1.20 and long term price elasticity, ranging between -0.34 to -2.50 [10,17].

Based on the empirical estimates presented in table.5 following observations can be made:

(1) Most of the estimates are based on All India data except in case of Parikh where he had attempted to estimate the functions for some States as well. However, In case of Parikh the model specification was of an extremely limited relevance and the empirical estimates lacked proper signs in some cases of price coefficients and equations indicated a very poor R^2.

(2) There is no uniformity in specifying the price variable in the models. All the models have taken the price of fertilizer in relation to output price, but some have only taken the price of nitrogen and others have taken weighted price of NPK. Again some have taken agricultural commodity price

others have taken harvest price and so on as deflators . Thus the estimates are not comparable overtime.

(3) It has been observed that positive elasticities of irrigation and HYV variables are much larger than the negative association of fertilizer price (relative to crop prices) and fertilizer consumption.

(4) As we have observed above, the fertilizer consumption per hectare differs widely between the States and also the percentage of irrigated area to total cropped area, and percentage coverage by HYV also differs widely between the States. The all India estimate of price elasticity does not convey the impact of prices on consumption on different crops in various States.

5) None of the models include any of the crucial non-price Variables like outlet intensity and credit availability. Subramaniyan and Nirmala [16] have made the efforts to include weather condition and land intensity in addition to other conventional variables.

6) It has been observed that long run elasticity are higher than the short run elasticities.

Thus, the empirical models in available literature have their shortcomings in terms of their specifications and aggregate data use in empirical estimation. Still if one is to use the short term elasticity of -.4263 of the price variable, the 30 per cent increase in the fertilizer prices with no change in agricultural commodities price could have led to adverse ratio of fertilizer price variable (specified as relative crop price) and would

have resulted in a decline in fertilizer consumption. This decline may not, however, have been in absolute terms because the positive elasticities of irrigation and HYV variables exert substantial positive influence fertilizer consumption nullifying the negative impact of price variables and both these are planned to increase as a result of larger investment in irrigation (including minor irrigation) and area under HYV. But still there would have been a fear of decline in rate of growth of fertilizer consumption affecting the envisaged level of agricultural production.

The fear of decline in rate of growth of fertilizer consumption from the desirable level is also not likely to come true. As indicated in Table 2. the percentage of fertilizer prices to index number of foodgrain prices as well as index number of all commodities price have been lower than 100 and thus in relative term the fertilizer has been cheaper than the foodgrain prices over the years.

As the 30 per cent increase in price of fertilizers, would have brought about increase in cost of cultivation from 0.1 per cent to 5.25 per cent, the pressure was growing for increasing the support price. The increases in support prices in major commodities announced recently are much more than the expected increases in cost of cultivation due to increases in fertilizer prices. Meanwhile open market price of foodgrains as well as all the commodities have also gone up rapidly to contribute to the estimated rate of inflation of the order of 15 per cent. Thus increase in fertilizer prices relative to foodgrain prices has been further toned down. Thus the fear of a decline in rate of

growth of fertilizer consumption is not based on the empirical observation. It has only produced, the kind of apprehension that GVK Rao Committee had envisaged, "If the prices of fertilizer go up, the cost of production of agricultural produce will also go up, and so also the support price, to be declared by the Government. This will lead to undesirable inflationary pressures"[6,p.V] . This committee had in fact recommended that prices of fertilizers could be increased by 5 to 7 per cent provided the country has achieved a cumulative increase of 30 per cent in the consumption of fertilizer during the preceeding three years.

Another fear has been in relation to fertilizer consumption by the small and marginal farmers. It has been mentioned that these farmers have limited cash availability for purchase of fertilizers, and increase in fertilizer prices would reduce the total purchasing power of these funds. This fear has become non existent because the small and marginal farmers have been exempted from the price increase in case of fertilizers. It all, however, depends as to how the dual policy is actually implemented.

Yet another apprehension has been in case of dryland and rainfed agricultural regions and also the eastern region. It has been indicated that even with the available technology, the profitability of fertilizer use in the crops grown in these regions is substantially high and lower current use of fertilizer per hectare cannot be explained by price and profitability consideration. In their case non-price variables are much more important.

Areas for further Research

Although the available empirical models and prevailing levels of relative prices (fertilizer prices relative to crop prices), coverage of HYV and irrigation variable, do not indicate any prima facie decline of either absolute level of rate of growth of consumption, there is a need to refine the estimates of price elasticity, particularly by generating the functions at more disaggregate levels and better specification of models.

As mentioned above most of the fertilizer demand functions used for estimating elasticities are at aggregate all India level. There is need for estimation of those functions at disaggregate levels as follows:

1. Fertilizer demand functions cropwise at the state level,
2. Fertilizer demand functions at the state level with farm size classification - small, medium and large.

In addition to the conventional variables used in fertilizer demand functions, there is also a need to add atleast some variables as a proxy for non-price factors. For example, the outlet density in each state can be used as an additional variable. Similarly credit availability can also be used as an additional variable in models.

The price elasticity of fertilizers estimated in each State then needs to be used along with the elasticity of other variables in assessing the impact of raising fertilizer price on its consumption. Any differential elasticity for various sizes can also give the rationale for dual or differential pricing policy, if the administrative mechanism can be devised for implement-

ing such policies meaningfully.

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TABLE : 1

STATE-WISE PERCENTAGE OF COST OF FERTILIZER TO TOTAL COST OF CULTIVATION FOR VARIOUS CROPS

Paddy	Cotton	Sugar Cane	Jowar	Wheat	Groundnut	Gram	Potato	Bajra	Soyabean	Onion
13.62 g (4.09)	10.08 c (3.02)	7.30 k (2.19)	3.21 j (0.96)		4.96 g (1.49)					
0.32 j (0.10)										
4.78 g (1.43)		2.73 g (0.82)					3.23 g (0.97)			
	7.30 g (2.19)		5.65 g (1.70)		7.49 j (2.25)			7.69 j (2.31)		
11.28 k (3.38)	4.57 k (1.37)	8.78 j (2.63)		14.25 k (4.28)				2.06 k (0.62)		
						0.12 k (0.04)	3.71 g (1.11)			
8.09 j (2.43)	7.00 j (2.10)	12.39 j (3.72)	6.25 g (1.88)		4.06 j (1.22)					8.38 (2.51)
6.05 j (1.82)	7.88 j (2.36)		3.43 j (1.03)	7.69 j (2.31)	4.13 e (1.24)	3.31 k (0.99)			4.16 i (1.25)	
	11.04 g (3.31)	11.02 k (3.31)	7.20 j (2.03)							7.71 (2.31)
6.16 j (1.85)					2.71 j (0.81)					
13.98 f (4.19)	5.46 j (1.64)	8.31 a (2.43)		15.89 k (4.77)						
			6.25 g (1.88)	6.76 j (2.03)		0.73 j (0.27)				
	9.19 c (2.76)	9.63 k (2.89)	0.58 b (0.17)		2.47 g (0.74)					
7.35 g (2.21)		8.63 j (2.59)		13.77 j (4.13)		0.54 j (0.16)	8.46 i (2.54)	4.10 j (1.23)	0.00 j (0.00)	
3.69 h (1.11)				17.49 b (5.25)			17.00 d (5.10)			

d= 1979-80 g= 1983-84 j= 1986-87
e= 1980-81 h= 1984-85 k= 1987-88
f= 1981-82 i= 1985-86

Figures in paraenthesis indicate the impact of 30 per cent increase in fertiliser price on the total cost of cultivation in percentage terms.

Government of India, Directorate of Economics & Statistic, Department of Agriculture & Co-operation, Cost of Cultivation of Principal Crops in India, 1991

Figures in parantheses indicate the impact of 30 percent increase in fertilisers price on total cost of cultivation in percentage terms.

GROSS CROPPED AREA, ALL INDIA CONSUMPTION OF FERTILISER, GROSS IRRIGATED AREA, HYV COVERAGE AREA, AND PRICE INDEX OF FOODGRAINS, FERTILISERS AND ALL COMMODITIES.

Year	Gross Cropped Area	All India Consum. Of NPK	Fertilizer Consum. Kg per Ha	Gross Irrigated Area	HYV Area	Whole Price Index of Foodgrains	Whole Price Index of Fertilizer	Whole Price Index of All Com.	Percentage Share of: Irrig. to Cropped Area	Fertilizer Price index to Foodgrains index price	Fertilizer Price index to All Commodities	HYV to Gross Crop Area
	('000 ha)	('000 tons)		('000 ha)	('000 ha)	Base year 1970-71 = 100						
-70	162265	1982.00	12.21	36970	11413	95.60	98.00	94.80	22.78	102.51	103.38	7.
-71	165791	2256.60	13.61	38194	15400	100.00	100.00	100.00	23.04	100.00	100.00	9.
-72	165194	2656.27	16.08	38431	18173	103.40	100.60	105.60	23.26	97.29	95.27	11.
-73	162150	2767.87	17.07	39049	22321	119.50	105.60	116.20	24.08	88.37	90.88	13.
-74	169870	2838.55	16.71	40280	26038	141.90	113.90	139.70	23.71	80.27	81.53	15.
-75	164190	2573.30	15.67	41740	27337	195.80	203.00	174.90	25.42	103.68	116.07	16.
-76	170994	2893.73	16.92	43363	31900	174.10	214.70	173.00	25.36	123.32	124.10	18.
-77	167280	3410.88	20.39	43552	33560	152.70	186.50	176.60	26.04	122.13	105.61	20.
-78	172305	4285.82	24.87	46030	38930	170.40	177.40	185.60	26.71	104.11	95.58	22.
-79	174764	5116.94	29.28	48090	40130	172.60	175.20	185.80	27.52	101.51	94.29	22.
-80	169657	5255.43	30.98	49178	38400	185.40	167.20	217.60	28.99	90.18	76.84	22.
-81	173096	5515.57	31.86	49875	43100	216.70	242.70	257.30	28.81	112.00	94.33	24.
-82	177042	6067.15	34.27	51554	46493	237.40	273.66	281.30	29.12	115.27	97.28	26.
-83	173396	6402.44	36.92	52121	47480	248.80	277.70	288.70	30.06	111.62	96.19	27.
-84	180165	7710.08	42.79	53937	53700	273.80	267.50	316.00	29.94	97.70	84.65	29.
-85	176418	8210.95	46.54	54083	54100	276.20	262.50	338.40	30.66	95.04	77.57	30.
-86	178831	8474.07	47.39	54652	55400	295.70	266.90	357.8	30.56	90.26	74.59	30.
-87	176920	8738.36	49.39	55636	56200	298.60	288.80	376.8	31.45	96.72	76.65	31.
-88	N.A.	8695.82		N.A.	54100	331.90	288.50	405.4		86.92	71.16	
-89	N.A.	11035.94		N.A.	60100	389.90	288.40	435.3		73.97	66.25	
ound Rate	0.24	3.88	3.74	1.13	3.28	2.95	2.70	3.54				
ple Rate	0.51	9.46	8.57	2.43	9.14	7.68	5.85	8.35				

1. Compound rate of growth is computed by using the equation Log y = a + bt.
2. Simple rate of growth is computed from two points of time (first and last year data).

s 1 : Fertiliser Association of India, Fertiliser Statistics 1989-90
2 : Centre for Monitoring Indian Economy, Index No of Wholesale Prices : Monthly data : 1984-85 & Annual data 1950-85, May 1 & Monthly data 1986-87 & Annual data 1950-89, May 1989.

TABLE:3

PROCURMENT COMMODITIES STATUTORY PRICES FIXED BY THE GOVERNMENT FOR AGRICULTURAL COMMODITIES (ACCORDING TO CROP YEAR)

(Rupees per quintal)

Year	Crops							
	Wheat	Paddy	Jower	Bajra	Tur	Ground-nut	Sugar-cane	Cotton
1971-71	76	47	55	55	NA	NA	NA	NA
1975-76	105	74	74	74	NA	90	NA	NA
1979-80	115	95	95	95	165	190	12.50	275
1980-81	117	105	105	105	190	206	13.00	304
1981-82	130	115	116	116	NA	270	13.00	NA
1982-83	142	122	118	118	215	295	13.00	380
1983-84	151	132	124	124	245	315	13.50	400
1984-85	152	137	130	130	275	340	14.00	535
1985-86	157	142	130	130	300	350	16.50	535
1986-87	162	146	132	132	320	370	17.00	540
1987-88	166	150	135	135	325	390	18.50	550
1988-89	173	160	145	135	360	430	19.50	600
1989-90	183	185	165	145	425	500	22.00	690
1990-91	215	205	180	180	480	580	23.00	750
% increase over the period	182.9[1]	336.2[1]	227.3[1]	227.3[1]	190.9[2]	444.4[3]	84.0[2]	172.7[2]

1. % increase in 1990-91 over 1971-71
2. % increase in 1990-91 over 1979-80
3. % increase in 1990-91 over 1975-76

Source: Government of India, Economic Survey - 1990-91, 1985-86, 1980-81, Ministry of Finance, Economics Division.

TABLE : 4

STATE-WISE PERCENTAGE SHARE OF FERTILISER CONSUMPTION, GROSS CROPPED AREA, HYV COVERAGE, GROSS IRRIGATED AREA, PERCENTAGE OF HYV TO GROSS CROPPED AREA, AND PERCENTAGE OF IRRIGATED AREA TO GROSS CROPPED AREA

State	Percentage of fertiliser consumption to all India fertiliser cost 1989-90	Gross Cropped Area ('000 ha) 1986-87	Percentage Irrigated area to gross cropped area	Gross Irrigated Area ('000 ha) 1986-87	HYV Coverage ('000 ha) 1986-87	Percentage of HYV to gross cropped area
Arunachal Pradesh	0.002	201.00	11.44	23.00	N.A.	ERR
Assam	0.20	3644.00	15.70	572.00	1.16	0.03
Bihar	5.18	10432.00	36.72	3831.00	5.48	0.05
Manipur	0.07	189.00	39.68	75.00	96.00	50.79
Meghalaya	0.05	206.00	24.76	51.00	45.00	21.84
Mizoram	0.005	71.00	11.27	8.00	N.A.	ERR
Nagaland	0.002	191.00	28.80	55.00	23.00	12.04
Orissa	1.68	9270.00	22.52	2088.00	1.90	0.02
Sikkim	0.02	134.00	11.94	16.00	39.00	29.10
Tripura	0.10	408.00	10.78	44.00	155.00	37.99
West Bengal	0.48	8211.00	23.27	1911.00	2.64	0.03
Haryana	4.90	5661.00	69.10	3912.00	2700.00	47.69
Himachal Pradesh	0.33	983.00	17.40	171.00	501.00	50.97
Jammu & Kashmir	0.50	1026.00	39.38	404.00	547.00	53.31
Punjab	10.50	7217.00	91.31	6590.00	5042.00	69.86
Utter Pradesh	19.19	27198.00	47.46	12908.00	11494.00	42.26
Chandigarh	0.01	4.00	75.00	3.00	N.A.	ERR
Delhi	0.08	87.00	74.71	65.00	N.A.	ERR
Andhra Pradesh	14.06	11693.00	37.29	4360.00	4159.00	35.57
Karnataka	7.15	11821.00	19.01	2247.00	2163.00	18.30
Kerala	1.96	2870.00	14.84	426.00	417.00	14.53
Tamil Nadu	7.14	6508.00	43.70	2844.00	2601.00	39.97
Pondichery	0.16	43.00	83.72	36.00	N.A.	ERR
Andaman & Nicobar	0.01	36.00	N.A.	N.A.	N.A.	ERR
Gujarat	6.27	10962.00	24.72	2710.00	2074.00	18.92
Madhya Pradesh	6.18	22214.00	15.56	3456.00	4141.00	18.64
Maharastra	10.85	19838.00	12.41	2462.00	5740.00	28.93
Rajasthan	2.85	17640.00	24.67	4351.00	2948.00	16.71
Goa, Diu & Daman	0.05	130.00	11.54	15.00	N.A.	ERR
Dadra Nagar Havaliy	0.01	N.A.	N.A.	2.00	N.A.	N.A.
All Others	0.00	N.A.	N.A.	N.A.	117.00	N.A.
All India	100.00	176920.00	31.45	55636.00	56174.00	31.75

Source : Fertilizer Association of India, Fertilizer Statistics 1989-90;1988-89

TABLE:5

REVIEW OF VARIOUS MODELS OF PRICE ELASTICITY OF FERTILIZER DEMAND

Author	Data	Empirical Model	Price Elasticity of Fertilizer Demand		Adjusted Coeffici
			Short Term	Long Term	
G Subramaniyan & V Nirmala[1] (1991)	1966-67 to 1985-86	$\log (F/ha) = -1.738 - 0.4263^{\$}\log (P_f/P_A) + 0.09374^{\$}\log MV +$ (-3.0337) (7.367) $1.438^{\$}\log IRR + 0.0814^{\$}\log W - 0.0665^{\$\$}\log T_i$ (2.63) (2.262) (-1.7572) $-2.6283^{\$}\log S + U$ (-2.289)	-.4263	---	---
		$R^2 = 0.09943$			
		Where F/ha = Consumption of fertilizer in kg/ha P_f/P_A = ratio of price of fertilizer to agricultural commodity price MV = Percent of area planted to HYV W = Weather condition IRR = per cent of area irrigated S = measure of land intensity (gross area sown per capita) T_i = Trend variable In the above model, MV and IRR are regarded as proxy varibles for Technological shifts.			
		Dynamic Model			
		$\log F_t = 4.823 - 1.296 \log P_{ft} + .1641 \log F_{t-1}$ (1.53) (3.09)	-1.30	-1.54	0.84
		$R^2 = 0.65$			
		Where F_t = actual fertiliser consumption P_{ft} = price of fertiliser relative to price of agricultural commodities.			
Peter C[2]					
1.	1953-54 to 67-68		-0.31 $^{\$\$}$	-0.34	0.92
2.	1953-54 to 67-68		-0.53 $^{\$}$	-6.63	0.08
3.	1958-59 to 63-64		-1.20 $^{\$\$}$	-2.50	0.50

Ashok K Parikh[3] (1965) 1951 to 1961

Model I

$$\log Y_t = \log A_1 + b_1 \log X_{1t} + b_2 \log X_{2t} + U_{it}$$

Where Y_t = Consumption of Nitrogenous fertilisers (in Nitrogen tons)
X_{1t} = Total Irrigated Area
X_{2t} = Deflated fertiliser price (Price per ton of Nitrogen / farm harvest price index number x 100)
U_{1t} = Stochastic variable
A_1, b_1, b_2 are parameters.

Model. 2

$$\log Y_t = \log A_2 + b_1 \log X_{1t-1} + b_2 \log X_{2t} + U_{it}$$

Where X_{1t-1} = Irrigated Area in previous year

States	Model No.	Regression Coefficients b_1	b_2	R^2			
Bihar	(1)	3.0593	2.3771$_s$	.445	2.3771[$]	---	---
		(1.3104)	(0.7933)				
	(2)	1.1770	2.5394	.218	2.5394	---	---
		(1.5488)	(1.2810)				
Kerala	(1)	4.5344	0.2589	.410	0.2589	---	---
		(2.2358)	(1.4900)				
	(2)	6.1964[$]	-0.4264	.880	-0.4264	---	---
		(0.6037)	(0.7344)				
Madras	(1)	2.9181[$]	-.8048	.692	-0.8048	---	---
		(.7600)[$]	(.9710)				
	(2)	2.6896[$]	-1.1325	.811	-1.1325	---	---
		(.6667)	(.7726)				
Mysore	(1)	3.8392[$]	.6388	.888	0.6388	---	---
		(.4256)	(1.8400)				
	(2)	1.5624[$]	-2.1985[$]	.907	-2.1985[$]	---	---
		(.3662)	(.6470)				
Orissa	(1)	3.1302	.6781	.232	0.6781	---	---
		(1.3926)	(2.8400)				
	(2)	2.9365	2.7014	.168	2.7014	---	---
		(1.6011)	(2.3051)				
Punjab	(1)	10.9500[$]	1.7524	.841	1.7524	---	---
		(1.7427)	(1.4076)				
	(2)	9.8933[$]	3.0678[$]	.876	3.0678[$]	---	---
		(1.3050)	(1.2294)				
All-India	(1)	6.5458[$]	-.2410	.801	-0.2410	---	---
		(1.1340)	(.7750)				

a Detailed model not Reported
‡ Significant at 5 per cent level
‡‡ Significant at 10 per cent level
Note: The figure in brackets are standard errors.

1. G. Subramaniyan and V. Nirmala, "A Macro Analysis of Fertilizer Demand in India (1966-67 to 1985-86)" Indian Journal of Agricultural Economics, Vol 46 No.1,Jan- March 1991.

2. Timmer Peter C, "The Demand for Fertilizer in Developing Countries", Food Research Institute Studies, Vol.13, No.3, 197

3. Ashok.K.Parikh, " Demand for Nitrogenous Fertilizers : An Econometric Study", Indian Journal of Agricultural Economics, Vol. 20, No.3, July - Sept. 1965.