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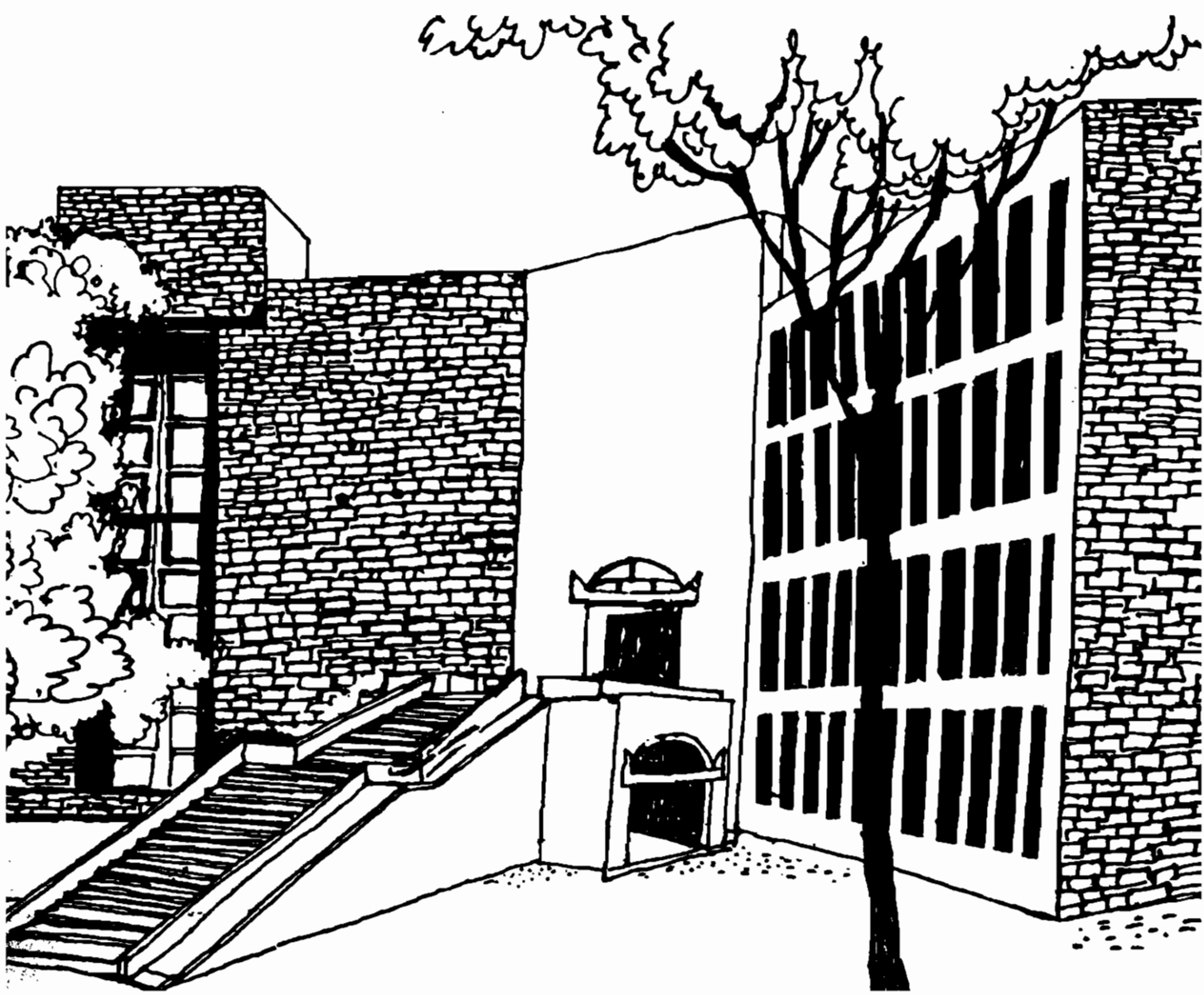

FERTILISERS IN INDIA'S AGRICULTURAL DEVELOPMENT, PROBLEMS AND POLICIES

Gunvant M. Desai

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PREFACE

The importance of fertiliser in agricultural production has increased substantially in the last 25 years. The current level of its use, however, is insufficient to arrest depletion of soil fertility. Under our circumstances the use of organic manures alone will not suffice to arrest this process. Thus, there is no alternative to continuously raising levels of fertiliser use, more so because further growth in agricultural production critically depends on intensive cultivation of land.

Neither the past record of achieving the planned targets of fertiliser use, nor the trends in the growth of fertiliser consumption could be relied upon to attain even the scaled-down levels of fertiliser use laid down in the Fifth Five Year Plan. To attain these levels, for instance, fertiliser use must grow by over 600,000 tonnes every year upto 1983-84. Against this, in the first half of this decade it increased only 68,000 tonnes a year. Thus the task of generating the requisite acceleration in the trends of fertiliser consumption is by any standard stupendous.

Clearly, marginal manipulations of the price environment and other ad hoc measures do not size up to this task. What is required are vigorous policies based on the correct understanding of the forces which have governed the past growth in the use of this input.

Past research provides valuable insights into some of the major aspects of the problem of increasing fertiliser use. These insights are brought together in this paper to highlight the nature of the problem. It also points out why the past policies which emphasised the supply and distribution aspects will not suffice in the current context. Finally, the paper suggests a workable strategy to generate continuous rapid growth in demand for this input.

The paper results from my efforts, spread over a decade to understand the forces which govern the growth of fertiliser use in India. I shall be grateful for critical comments on this paper as it presents in a nutshell what I am attempting in a more comprehensive work on the subject.

Gunvant M. Desai

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Gunvant M. Desai
Centre for Management in Agriculture
Indian Institute of Management, Ahmedabad

Introduction

During the last 25 years or so, the importance of fertilisers in India has grown phenomenally. The total annual consumption has increased by over 40 times — from about 60 to 70 thousand tonnes of plant nutrients in the early 1950s to nearly 3 million tonnes in 1975-76. The domestic production of fertilisers has also increased from less than 10,000 tonnes on the eve of the Independence to over 1.8 million tonnes in 1975-76. India now ranks among major fertiliser producing and consuming nations of the world. While this is no mean achievement, the per hectare consumption is still quite low (17 kgs); and on this basis, India still comes in the bottom 25 per cent of the countries. Similarly, though the value of fertiliser used annually has increased from about Rs. 10 crores in the early 1950s to over Rs. 1,100 crores in mid-1970s, it still accounts for barely 3 per cent of the gross value of total agricultural production.

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What underscores the importance of fertilisers at this stage, however, is the increasing dependence of growth in agricultural production on fertilisers due to limited scope for extensive cultivation. Clearly, fertiliser is important in any strategy of intensive cultivation of land because yields depend on soil fertility. Through centuries of cultivation, the fertility of most Indian soils has gone down considerably creating a widespread deficiency of nitrogen and phosphorus.[1] Soils in many areas are also deficient in potassium as well as in such micro-nutrients as iron, zinc, copper and manganese. On the other hand, the depletion of soil fertility is not yet arrested. Even at the present level of yields, different crops remove over 4 million tonnes of nitrogen, 2 million tonnes of phosphoric acid, 7 million tonnes of potash, and nearly 5 million tonnes of calcium from soils every year.[2] Against this, the level of fertiliser use, even as late as 1975-76, was 2.12 million tonnes of nitrogen, 0.49 million tonnes of phosphorus, and 0.29 million tonnes of potash. This compares quite unfavourably with even the current needs. With further spread of high yielding varieties, and increase in the areas under double and multiple cropping, it is all the more imperative to raise the current levels of fertiliser use.

The past growth in fertiliser use, though impressive, has been consistently less than what was targetted in various Five Year Plans. More importantly, there has been a virtual stagnation in the growth

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[1] J. S. Kanwar and N.P.Datta, "Soil Science" in Agricultural Year Book, (New Delhi: ICAR, 1970).

[2] Ibid., p. 235

of fertiliser use between 1971-72 and 1975-76. The impact of the Oil Crisis on fertiliser prices also has adverse implications for the growth of fertiliser use. Thus, a systematic analysis of the various issues related to fertiliser use is one of the high priority areas in understanding the problems and policies of agricultural development at this stage.

An attempt is made in this chapter towards understanding the forces which govern the growth of fertiliser use in India. Section I focuses on the forces which led to recognising the importance of fertilisers. Section II presents a brief overview of the past growth in fertiliser use. In the subsequent three sections, we have examined questions related to availability of, and distribution arrangements and demand for fertilisers. Growth of fertiliser use depends on each of these three factors and interactions among them. Therefore, to understand the dynamics of growth of fertiliser use, it is necessary to understand the problem areas in each of these three spheres. Finally, Section VI brings together major findings of the analysis, and examines their implications for the future growth in the use of fertilisers.

Section I

Recognition of the Importance of Fertilisers

The problem of plant nutrient deficiency in Indian soils was recognised as early as in 1890s. After an extensive investigation, Voelcker stressed in his Report on the Improvement of Indian Agriculture (1893) that the question of increasing the supply of plant nutrients was "indissolubly bound up with the well-being and even the bare

existence of the people of India."[3] He not only emphasized the importance and urgency of the problem but advocated government action in the matter.[4] In the 50 years which followed, a number of committees, commissions and research workers highlighted the importance of increasing the supply of plant nutrients to Indian soils. Though fertiliser use began during this period, the decisive recognition of its importance was postponed till early 1940s.

When Japan began its assault on Burma in 1942, the government became acutely aware that India could no longer rely on imports of rice from Burma to supplement the domestic availability of food. Consequently, the Central Government undertook direct efforts to increase food production rapidly by launching the Grow More Food (GMF) campaign. These efforts got further impetus, first because of the Bengal famine of 1943, and then because of the impact of the partition on domestic availability of foodgrains in India.

The basic strategy of the GMF campaign was (i) to expand the area under food grains, (ii) to augment irrigation facilities, (iii) to increase the supply of improved seeds with high yield potential, and (iv) to extend the use of manures and fertilisers to foodgrain crops. The importance given to manures and fertilisers during

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[3] John Augustus Voelcker, Report on the Improvement of Indian Agriculture, (London: Eyre and Spottiswoode, 1893), p. 41

[4] "In conclusion, it is maintained that water and manure constituted the cultivator's chief wants, and that the supply of manure must go hand in hand with the water, and must, like the latter, be taken up by government, otherwise the soil will not be able to provide for the increasing millions of people." Ibid., p. xi.

[5] Government of India, Ministry of Food & Agriculture, Report of the Grow More Food Enquiry Committee, (New Delhi, 1953), p. 13.

these years is clearly revealed by the following remarks of the Famine Inquiry Commission:

> "Next to the provision of an assured supply of water, the use of manure offers the most important single means of increasing the yield of crops. Experience has shown that the plant food, abstracted by low yielding varieties of crops, is replaced through the operation of the natural recuperative powers of the soil, assisted by the small quantity of manure occasionally applied, and that the fertility of the soils of India has thus become stabilized at a low level. If, therefore, the yield of crops is to be increased and in particular if the full benefit is to be derived from improved varieties, plant food must be added to the soil in very considerable quantities. Hitherto the use of manures has been confined largely to the more profitable among the cash crops, such as tobacco, sugarcane and vegetables, and the amount of manure used is, however, not a single problem but a whole series of problems, none of which is easy of solution. Yet, if the standard of living of the Indian cultivator is to be raised, it is essential that the use of organic and inorganic manures should be greatly extended. If this is to be achieved, every source of fertilizing material must be utilized to the fullest extent, the supply and distribution of manures and fertilizers must be organized as to ensure that they are available in all parts of the country at the cheapest possible rates, cultivators must be educated in their use and Agricultural Departments must be in a position to give detailed advice as to the quantity and the manner in which they should be applied."[6]

The First Five Year Plan (1951 to 1956) recognised the problem of low fertility of Indian soils.[7] It observed that manuring was necessary "to provide nourishment to soil." Prime importance was given to organic manures but the plan also laid down that it

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[6] The Famine Inquiry Commission, Final Report, (Delhi, 1945), p. 144.

[7] Government of India, Planning Commission, First Five Year Plan, (New Delhi, 1951), pp. 254-259.

was not necessary to wait for full mobilization of organic manures before introducing inorganic fertilisers. Perhaps, this reflects the planners' practical wisdom under the prevailing circumstances. On the one hand, there was lack of adequate empirical evidence on physical response of crops to fertiliser, resistence of cultivators to adopt fertiliser use on foodgrain crops, and a growing criticism in some quarters that fertilisers were being pushed without fully mobilising the local manurial resources. On the other hand, it was becoming increasingly clear that complete mobilisation of indigenous manurial resources, particularly cowdung, was hampered by non-availability of cheap alternative fuel, and the progress of green manuring was not satisfactory.

While the First Plan viewed fertilisers as supplementary to organic manures, the Second and the subsequent Five Year Plans gave a direct and crucial role to fertilisers in the planned efforts to increase agricultural, and more particularly foodgrain, production.

Over years the government had evolved rough input-output coefficients (known as "yardsticks") which indicated increase in production as a result of such measures as increase in irrigated areas, fertiliser use, and use of improved seeds. From Second Plan onwards, such yardsticks have been used to estimate the requirements of various inputs to achieve the planned targets of additional agricultural production. Thus, a <u>need-based</u> approach to fix the targets of fertiliser use was evolved in the Second Plan, and it continued upto the formulation of the Draft Fifth Five Year Plan. In the Second Plan, 25 per cent of the target of 10 million tons of additional food-

rains was to be achieved by increase in fertiliser use.[8] In the subsequent plans, this percentage was considerably higher.

Several factors were responsible for the enhanced importance of fertilisers in the 1960s.[9] There was little scope to bring additional land under cultivation — the main factor behind growth in production during the 1950s. Various institutional reforms by themselves were not contributing much to raising the productivity of land. Consequently, the emphasis shifted to improving the productivity of land through intensive cultivation. The strategy for this purpose was formalised, first in 1960 in the Intensive Agricultural District Programme (IADP), and later in 1966, in the High Yielding Varieties Programme (HYVP).

Both IADP and HYVP increased the importance of fertiliser considerably, because fertiliser was the main element in the package of practices advocated in IADP, and the success of HYVP depended

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[8] Government of India, Planning Commission, Second Five Year Plan, (New Delhi, 1956), p. 268

[9] For a discussion on the importance of fertilisers during 1960s, see Government of India, Ministry of Food and Agriculture, Report of the Fertiliser Distribution Enquiry Committee, (New Delhi, 1960), pp. 1-10; Government of India, Planning Commission, Third Five Year Plan, (New Delhi, 1961), pp. 304-306, 311-312; Government of India, Ministry of Food and Agriculture, Approach to Agricultural Development in the Fourth Five Year Plan, (New Delhi, 1964), pp. 24-28; Government of India, Ministry of Food and Agriculture, Report of the Committee on Fertilisers, (New Delhi, 1965), pp. 1-16; Government of India, Planning Commission, Fourth Five Year Plan: A Draft Outline, (New Delhi, 1966), pp. 173, 196-197, 251-253, 270-272; and Government of India, Planning Commission, Fourth Five Year Plan, 1969-74, Draft. pp. 106-109, 112-115, 121-122.

crucially on the responsiveness of the high yielding varieties (HYVs) to increased levels of fertiliser use. In fact, the success of the HYVs of wheat in breaking the yield barrier, and the complementarity between these varieties and fertiliser led many agencies to make need-based estimates of fertiliser use for various years in 1970s (Table 1). These estimates imply many-fold increases in fertiliser use during a relatively short time. The need-based recognition of the importance of fertiliser continued even in the Draft Fifth Year Plan which envisaged raising fertiliser use from anticipated level of 3 million tonnes in 1973-74 to 8 million tonnes in 1978-79.[10]

The final version of the Fifth Five Year plan, published in 1976, however, makes no reference to the need-based estimates of the Draft Outline of Fifth Five Year Plan. Instead, it refers to an estimated demand of 4.8 million tonnes in 1978-79 and approximately 8 million

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10 Government of India, Planning Commission, Draft Fifth Five Year Plan, 1974-79, Vol. II, (New Delhi, 1974), p. 8.

Table 1 Need-based Estimates of Fertiliser Use

	Nitro-genous	Phos-phatic	Potassic	Total
	In Million Tonnes of Nutrients			
Estimates for 1970-71				
Committee on Fertilisers[a]	2.40	1.00	0.77	4.17
USAID (Standstill)[b]	1.96	0.98	0.49	3.43
USAID (Minimum Acceptable)[c]	2.69	1.34	0.67	4.70
Donahue	2.67	1.80	0.93	5.40
Holst (Food Self-sufficiency, 1976)	1.96	0.88	0.43	3.27
Holst (Food Self-sufficiency, 1971)	2.50	1.10	0.60	4.25
Estimates for 1973-74				
Draft Fourth Five Year Plan[d]	3.70	1.80	1.10	6.60
Fertiliser Association of India[e]				
(a) On the basis of 1963-64 to 1967-68 trends	4.22	2.32	0.77	7.31
(b) Population-nutrition basis	3.07	1.53	0.77	5.37
(c) Area-crop Approach	3.68	2.20	1.67	7.55
(d) To get 5 per cent annual growth in foodgrain production	3.54	1.77	0.88	6.19
Estimates for 1975-76				
Committee on Fertilisers	4.00	2.00	1.20	7.20
USAID (Standstill)[b]	3.08	1.54	0.77	5.39
USAID (Minimum Acceptable)[c]	4.37	2.18	1.09	7.64
Holst (Food Self-sufficiency, 1976)	3.88	1.96	0.97	6.81
Estimates for 1978-79				
Draft Fifth Five Year Plan	5.20	1.80	1.00	8.00

contd ...

a The recommendation of the Committee was accepted by the Government and the target for 1970-71 was originally set at 2.4 million tonnes of nitrogen, 1.0 million tonnes of phosphorus, and 0.7 million tonnes of potash. See Report of the Fertiliser Credit Committee of the Fertiliser Association of India, (New Delhi, 1968), p. 18

b These estimates were derived from the requirements of foodgrains which imply no change in dietary levels, and self-sufficiency by mid-1970s.

c These estimates were derived from the requirements of foodgrains which imply some improvement in dietary levels and self-sufficiency by 1970-71.

d The targets laid down in the Draft Fourth Five Year Plan were subsequently revised downwards to 3.2 million tonnes of nitrogen, 1.4 million tonnes phosphorus, and 0.9 million tonnes of potash. See Fertiliser Statistics, 1969-70, The Fertiliser Association of India, (New Delhi, 1970), p. 194.

e On the basis of the four estimates, the Fertiliser Association of India suggested the target of 3.8 million tonnes of nitrogen, 1.9 million tonnes of phosphorus and 0.9 million tonnes of potash for 1973-74.

Sources:

1 Report of the Committee on Fertilisers, Government of India, Ministry of Food and Agriculture, Department of Agriculture, (New Delhi, 1965).

2 Fertiliser Proposal for Increased Agricultural Production, United States Agency for International Development Mission to India, American Embassy, (New Delhi, 1964), (Mimeographed).

3 Roy L. Donahue, Estimates of fertiliser Consumption in India in 1970-71, The Fertiliser Association of India, (New Delhi, 1966).

4 The World Food Problem, A Report of the President's Science Advisory Committee, (The White House, Washington, D.C., 1967), Vol. II, pp. 673-711.

5 Fourth Five Year Plan, 1969-74, Draft, Government of India, Planning Commission, (New Delhi, 1969), p. 121.

6 Report on the Development of the Fertiliser Industry during the Fourth Plan Period, The Fertiliser Association of India, New Delhi, p. 5, also Appendix III-A, III-B, III-C, and III-D, pp. 32-46.

7 Draft Fifth Five Year Plan, 1974-79, Vol. II, Government of India, Planning Commission, (New Delhi, 1973), p. 8

tonnes in 1983-84.[11] Does this represent a shift in the importance attached to fertiliser in the future agricultural production strategy?

The need-based approach in setting the targets of fertiliser use was primarily concerned with the supply and distribution rather than the demand aspect of increasing fertiliser use. Under the prevailing circumstances, perhaps, this was understandable. Supply of fertilisers involved crucial macro policy decisions about investment in the domestic fertiliser industry and allocation of scarce foreign exchange for imports of finished fertilisers, and raw materials and equipment for the domestic fertiliser industry. Similarly, the distribution of available supplies involved questions of allocation among different states, development of distribution networks, and

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[11] Government of India, Planning Commission, Fifth Five Year Plan, (New Delhi, 1976), p. 10. The relevant paragraph reads as follows:

> "The estimation of fertiliser demand is sensitive to the increase in irrigation facilities and the spread of new technologies. The demand is estimated in terms of nutrients at 4.80 million tonnes in 1978-79 and approximately 8 million tonnes in 1983-84. Suitable investment decisions in relationship to these fertiliser demands are being made in the area of nitrogenous and phosphatic fertilisers. Still there will be some area of uncertainty in estimation of demand arising both from the lack of fully disaggregated data and relationship of fertiliser applications to behavioural responses. Any spurt in demand may, therefore, have to be met from imports. The requirements of potassic fertilisers will continue to be met substantially out of imports."

many issues related to the logistics of moving fertilisers from domestic factories and ports to various locations. Against this, because of the prevailing low levels of use, one was likely to take for granted the growth in cultivators' demand for fertilisers at a pace comparable to the growth in supplies. The dramatic diffusion of fertiliser responsive HYVs of wheat as well as the buoyant trends in prices of agricultural output from mid-1960s further contributed to a relative neglect of the demand aspect, until fertiliser prices went up by nearly 100 per cent as a result of the Oil Crisis. The decline in fertiliser consumption by 250,000 tonnes in 1974-75, the first year of the Fifth Plan, accentuated the concern about demand for fertilisers.

The scaling down of the need-based target of 8 million tonnes of fertiliser consumption in 1978-79 to the demand-based estimate of 4.8 million tonnes is a reflection of the above concern. In no basic sense it implies reduced importance of fertilisers in agricultural production. The growth in foodgrain production envisaged in the final version of the Fifth Five Year Plan is considerably lower than the target envisaged in the Draft Fifth Five Year Plan.[12] Hence, it would be erroneous to say that in the agricultural production strategy of the final version of the Fifth Plan, the importance of fertilisers has

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[12] See Government of India, Planning Commission, Draft Fifth Five Year Plan, 1974-79, Vol. II, (New Delhi, 1974), p. 6, and Fifth Five Year Plan, 1974-79, (New Delhi, 1976), pp. 10 and 54.

declined. In fact, to achieve the revised targets of the final version of the Fifth Plan, fertiliser consumption must increase by over 600,000 tonnes every year till 1983-84. As shown in the next section, the recent trends in the growth of fertiliser use need unprecedented acceleration to attain such a growth rate. Viewed thus, the relevant question is not whether the importance of fertiliser has declined but what policy measures are required to bring about the acceleration in the trends of fertiliser use. The rest of the chapter is an attempt to answer this question by understanding of the factors governing the growth in fertiliser use under Indian conditions.

Section II

Overview of Growth in Fertilizer

Pre-Independance Period

Fertiliser use in appreciable quantities began in 1920s when tea plantations started using ammonium sulphate.[13] In the 1930s, the use spread to sugarcane, and in some areas to rice. It appears that three main factors contributed to the beginning of fertiliser use outside the plantations. These were: (i) Development of domestic sugar industry, (ii) fixation of the minimum price for sugarcane by the Governments of

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[13] Royal Commission on Agriculture in India, Report, (Bombay, 1928), p. 89, also see Sir Henry Knight, Food Administration in India, 1939-47 (Stanford, California: Stanford University Press, 1954), pp. 133-135.

the United Provinces an Bihar, and (iii) efforts of some commercial firms importing fertilisers to develop market for fertiliser outside the plantation agriculture. By 1939-40, the country was using about 18 to 20 thousand tonnes of nutrients.

As stated in Section 1, early 1940s marked the beginning of the new era in the importance given to fertiliser use in Indian agriculture. The level of use, however, could not be stepped up till 1946-47 because of limited availability of fertiliser. On the eve of the Second World War, imports accounted for over 80 per cent of the domestic availability; and as the War gathered momentum, imports declined sharply. Nor could domestic production be stepped up immediately because it came mainly as a by-product of the iron and steel industry. Thus, the beginning of the period marked by a policy decision to increase fertiliser use in the non-plantation agriculture was also marked by scarcity of fertiliser.

Post-Independence Period

Until 1950, the availability of fertilisers in the world market was limited. The domestic availability, however, improved due to the establishment of two factories, one at Alwaye in Kerala and the other at Sindri in Bihar. In 1951-52, when the First Five Year Plan was launched, about 60 to 70 thousand tonnes of NPK was consumed. In the subsequent 25 years, this amount increased to 2.9 million tonnes. The following paragraphs highlight (i) the targets and achievements of fertiliser use in

various Five Year Plan periods, and (ii) some of the salient features of the trends in fertiliser consumption.

Targets of Fertiliser Consumption in Five Year Plans

Table 2 presents the targets and achievements of fertiliser consumption in different Five Year Plan periods. The term "level of consumption" in the table refers to estimates of distribution as distinguished from consumption in the case of the first three plans.

The table clearly shows that except in the case of the First Five Year Plan, the planned targets of fertiliser consumption remained unachieved to a significant extent. It is also clear that the need-based target of 8 million tonnes of fertiliser use in 1978-79, suggested in the Draft Fifth Five Year Plan, appears unattainable when compared with the 2.9 million tonnes consumption in 1975-76. More significantly, the attainment of even the revised demand-based target of 4.8 million tonnes, given in the final version of the Fifth Plan, depends on achieving an annual growth in fertiliser consumption by over 600,000 tonnes for three consecutive years. Similarly, the attainment of the 8 million tonnes level of fertiliser use in 1983-84, indicated in the final version of the Fifth Five Year Plan, also depends on achieving annual growth in fertiliser consumption by a similar magnitude from 1978-79 to 1983-84. Against this, what has been the past record?

Trends in Fertiliser Consumption

The estimates of annual consumption of fertiliser are available only from 1967-68 onwards. For the earlier period, only the esti-

Table 2 : Targets and Achievements of Fertiliser Consumption in Different Five Year Plans

	Nitrogenous	Phosphatic	Potassic	Total
	'000 Tonnes of Nutrients			
First Five Year Plan (1951-52 to 1955-56)				
Target of consumption in 1955-56	122	NA	NA	NA
Level of consumption in 1955-56	107	19	11	137
Percentage of target achieved	88	NA	NA	NA
Second Five Year Plan (1956-57 to 1960-61)				
Target of consumption in 1960-61	510	150	NA	NA
Level of consumption in 1960-61	210	70	28	308
Percentage of target achieved	41	47	NA	NA
Third Five Year Plan (1961-62 to 1965-66)				
Target of consumption in 1965-66	1,020	406	203	1,629
Level of consumption in 1965-66	580	132	77	789
Percentage of target achieved	57	33	38	48
Draft Fourth Five Year Plan (1966-67 to 1970-71)				
Target of consumption in 1970-71	2,000	1,000	350	3,350
Level of consumption in 1970-71	1,487	462	228	2,177
Percentage of target achieved	74	46	65	65
Draft Fourth Five Year Plan (1969-70 to 1973-74)				
Target of consumption in 1973-74	3,700	1,800	1,100	6,600
Level of consumption in 1973-74	1,829	650	360	2,839
Percentage of target achieved	49	36	3	58
Fifth Five Year Plan (1974-75 to 1978-79)				
Target of consumption in 1978-79				
Draft Fifth Plan	5,200	1,800	1,000	8,000
Final version of Fifth Plan	NA	NA	NA	4,800
Level of consumption in 1975-76	2,120	490	288	2,898

contd...

Table 2 contd ...

Note : The First Draft of the Fourth Five Year Plan (1966-67 to 1970-71) laid down the target of fertiliser consumption for 1970-71 as shown in the table. This was subsequently revised as nitrogen 2.4 million tonnes, phosphorus 1.0 million tonnes, and potash 0.7 million tonnes. Similarly, the Fourth Five Year Plan (1969-70 to 1973-74) laid down the targets of fertiliser consumption in 1973-74, as shown in the table. However, these were subsequently revised as nitrogen 3.2 million tonnes, phosphorus 1.4 million tonnes, and potash 0.9 million tonnes.

Sources:

1 For the First, Second and Third Five Year Plan, Government of India, Directorate of Economics and Statistics, Indian Agriculture in Brief, 11th Edition, (New Delhi, 1973), pp. 154-155.

2 The targets of the Fourth and the Fifth Five Year Plan are taken from Government of India, Planning Commission, Fourth Five Year Plan, A Draft Outline (New Delhi, 1966), p. 185; Government of India, Planning Commission, Fourth Five Year Plan, 1969-74, Draft (New Delhi, 1969), p. 121; Government of India, Planning Commission, Draft Fifth Five Year Plan, 1974-79, Vol. II, (New Delhi, 1974), p. 8; Government of India, Planning Commission, Fifth Five Year Plan, 1974-79, (New Delhi, 1976), p. 10

3 Consumption figures for 1970-71 and 1973-74 are from Fertiliser Association of India, Fertiliser Statistics, 1974-75, (New Delhi, 1975), pp. I-88, 89; and for 1975-76, from Fertiliser Marketing New, 7(3), March 1976, p. 2.

...tes of "distribution" ...e available.[14] ... have brought together in Table 3 the time series of annual distribution of fertiliser between 1952-53 and 1966-67, and the one of consumption between 1967-68 and 1975-76 to present indicative trends of fertiliser consumption between 1952-53 and 1975-76. Figure 1 shows these trends graphically.

Figure 1 shows that the growth parameters behind the past trends of fertiliser consumption changed over time. Hence, the period between 1952-53 and 1975-76 is divided into two sub-periods as: 1952-53 to 1966-67 and 1967-68 to 1975-76. This division roughly corresponds to the period before and after the introduction of high yielding varieties. Table 4 presents the growth parameters of fertiliser consumption during the two periods.

During 1952-53 to 1966-67, total fertiliser consumption (as ...dicated by distributio... increased from a...out 65 thousand tonnes to 1.2 million tonnes. This implies an average annual increment of about 80,000 tonnes, and a compound growth rate of 23.2 per cent per year over a period of 15 years. During the first seven years, the average annual increment in consumption was 34,000 tonnes while during the second half of the period, it was 128,000 tonnes. Despite increase in the base level, the compound growth rate declined only marginally in the second half of the period, as compared to the first half — from 24.7 to 21.7 per cent.

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[14] The term "distribution" in this context means distribution of fertilisers available from imports and domestic production among various state governments and plantation boards. Therefore, one needs data on stocks to derive estimates of consumption. Such data on stocks are not available.

Table 3 : Consumption of Fertilisers in India, 1952-53 to 1975-76

Year	Nitrogenous	Phosphatic	Potassic	Total
		000 Tonnes of Nutrients		
1952-53	58	5	3	66
1953-54	89	8	8	105
1954-55	95	15	11	121
1955-56	108	13	10	131
1956-57	123	16	15	154
1957-58	149	22	13	184
1958-59	172	30	22	224
1959-60	229	54	21	305
1960-61	212	53	29	294
1961-62	292	64	28	384
1962-63	360	81	37	478
1963-64	407	117	50	574
1964-65	435	148	70	653
1965-66	547	132	78	757
1966-67	839	248	116	1203
1967-68	800	236	130	1166
1968-69	1131	389	154	1675
1969-70	1360	420	209	1989
1970-71	1487	462	228	2177
1971-72	1760	564	304	2628
1972-73	1779	587	353	2699
1973-74	1829	650	360	2839
1974-75	1774	478	339	2591
1975-76	2120	690	288	2898

Notes : Figures upto 1966-67 relate to "distribution" and not consumption of fertilisers. Furthermore, in the case of nitrogen, they refer to allotments under Central Fertiliser Pool for the first four years. Figures from 1952-53 to 1956-57 relate to calender years ending the first half of the stated period. In the case of potash, the quantity imported is taken as distributed for the period 1952-53 to 1958-59 due to non-availability of distribution data. Finally, the figures exclude data in respect to bonemeal and rock phosphate.

Sources: Fertiliser Association of India, Fertiliser Statistics, 1974-75, (New Delhi, 1975), pp. I-88, 89; and Fertiliser Marketing News, Vol. 7, No. 3, March 1976, p. 2.

FIGURE 1 : PRODUCTION, IMPORTS AND CONSUMPTION OF FERTILISERS, 1952-53 TO 1975-76

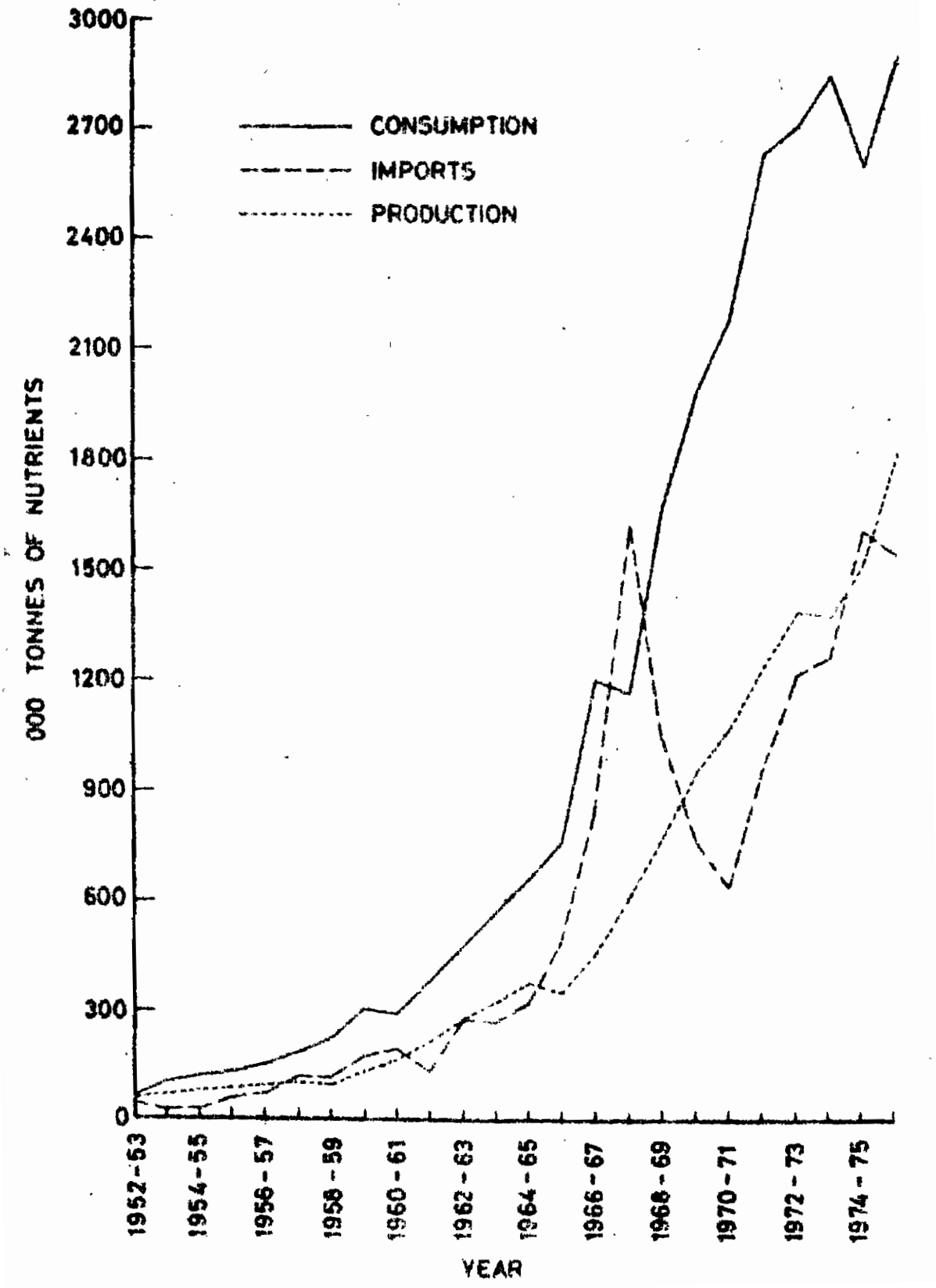

Table 4 : Growth Parameters of Fertiliser Consumption during 1952-53 to 1975-76

Periods	Nitrogenous	Phosphatic	Potasic	Total
	Average Annual Increament (000 Tonnes of Nutrients)			
1952-53 to 1966-67				
1952-53 to 1959-60	25	7	2	34
1959-60 to 1966-67	87	28	13	128
1952-53 to 1966-67	56	17	8	81
1967-68 to 1975-76				
1967-68 to 1971-72	240	82	44	366
1971-72 to 1975-76	90	-19	- 4	68
1967-68 to 1975-76	165	32	20	217
1952-53 to 1975-76	90	21	12	123
	Annual Compound Growth Rate (Per cent)			
1952-53 to 1966-67				
1952-53 to 1959-60	22	42	31	25
1959-60 to 1966-67	20	24	27	22
1952-53 to 1966-67	21	33	29	23
1967-68 to 1975-76				
1967-68 to 1971-72	22	24	24	23
1971-72 to 1975-76	5	- 3	- 1	3
1967-68 to 1975-76	13	10	10	12
1952-53 to 1975-76	17	23	21	19

Source : Derived from Table 2

Between 1967-68 and 1975-76, total consumption of fertiliser increased from about 1.2 million tonnes to about 2.9 million tonnes. This implies an average annual increment of about 220,000 tonnes over a period of 8 years. This compares very favourably with the rate of 34,000 tonnes per year from 1952-53 to 1959-60, and that of 128,000 tonnes from 1959-60 to 1966-67. But the trend in growth of fertiliser consumption during the period 1967-68 to 1975-76 was just the opposite of what it was during the previous 15 years. Between 1967-68 and 1971-72, the consumption increased at an average rate of 366,000 tonnes per year. The compound growth rate during this period, even on the much enlarged base of 1.2 million tonnes, was roughly the same (22.5 per cent) as the one during the previous 15 years. On the other hand, from 1971-72 to 1975-76, the average annual growth in consumption was only 68,000 tonnes -- less than one-fifth during the period 1967-68 to 1971-72. The compound growth rate also dropped sharply from 22.5 to only 2.5 per cent.

The conclusion which emerges from the above analysis of the past growth in fertiliser consumption is as follows. Neither the past record of achieving the planned targets of fertiliser consumption, nor the trends in fertiliser consumption during 1970s, could be considered satisfactory to attain the level of consumption laid down even in the revised Fifth Plan. Fertiliser consumption must increase by over 600,000 tonnes every year to attain the level of 4.8 million tonnes by 1978-79 and that of 8 million tonnes by 1983-84. Against this, even between 1967-68 and 1971-72 it increased by only 366,000 tonnes per year. What is, however, alarming is that from

1971-72 to 1975-76 the consumption has increased by only 58,000 tonnes per year. Thus, a stupendous task is ahead to generate the required growth in fertiliser consumption. To undertake this task, policies based on the correct understanding of the forces which have governed the past growth in fertiliser use are critically required.

Conceptually, the problem of increasing fertiliser consumption has three aspects. These are (i) availability of fertilisers, (ii) arrangements to distribute fertilisers and (iii) cultivators' demand for fertilisers. In the next three sections, we have made an attempt to examine the extent to which each of this aspect has governed the past trends in fertiliser consumption.

Section III

Availability of Fertilisers

This section focuses on availability of fertilisers at the macro (all-India) level. Availability of fertiliser at micro or consumer level is discussed in the next section on distribution arrangements for fertilisers.

The overall availability of fertilisers during a particular year is determined by domestic production and imports of fertilisers during the year plus carryover stocks of fertilisers from the previous year. In what follows, we first briefly review domestic production and imports of fertilisers, and then examine if availability was restricting the past growth in fertiliser use.

Relative Importance of Imports and Domestic Production

The production of phosphatic fertiliser on a small scale, based on crushed bones, started in India as early as 1906 to meet the demand of tea plantations. Until 1940, however, the domestic supply of nitrogenous fertiliser (ammonium sulphate) came as a by-product of the iron and steel industry. Thus, imports dominated even the small consumption of fertilisers during this period.

The role given to fertilisers in the Grow More Food campaign, and the difficulties of importing fertilisers resulting from World War II, initiated the development of domestic fertiliser industry during 1940s. However, till Sindri and Alwaye factories started production, imports continued to account for over 80 per cent of total availability of fertilisers.

Table 5 shows domestic production and imports of fertilisers between 1952-53 and 1975-76. These trends, shown in Figure 1, indicate that the period from 1952-53 to 1975-76 can be divided as : (i) 1952-53 to 1957-59, (ii) 1958-59 to 1964-65 and (iii) 1965-66 to 1975-76. During these three periods, on an average, fertiliser production increased every year by 9,500, 43,500 and 147,000 tonnes respectively. Despite this acceleration in production, the relative importance of imports increased over time. During the first period, imports accounted for 42 per cent of the availability from domestic production and imports. This percentage went up to 49 and 51 during the second and the third period respectively. Not only did imports account for nearly half of the availability of fertilisers, they also fluctuated over time as can be seen from Figure 1.

Table 5 : Production and Imports of Fertiliser, 1952-53 to 1975-76

Year	Production	Imports	Production + Imports	(3) as % of (4)
(1)	(2)	(3)	(4)	(5)
		'000 Tonnes of Nutrients		
1952-53	60	47	107	44
1953-54	67	26	93	28
1954-55	82	31	113	27
1955-56	89	61	150	41
1956-57	97	71	168	42
1957-58	107	123	230	54
1958-59	112	120	232	52
1959-60	135	179	314	57
1960-61	166	197	363	54
1961-62	219	174	393	44
1962-63	282	282	564	50
1963-64	327	274	601	46
1964-65	374	325	699	46
19[illegible]-66	357	492	849	58
1966-67	455	847	1302	65
1967-68	610	1623	2233	73
1968-69	776	1078	1854	58
1969-70	955	762	1717	44
1970-71	1061	633	1694	37
1971-72	1239	971	2210	44
1972-73	1386	1216	2603	47
1973-74	1374	1256	2630	48
1974-75	1517	1608	3125	51
1975-76	1828	1541	3369	46

Source : Compiled from Fertiliser Association of India, Fertiliser Statistics, 1974-75, (New Delhi, 1975), pp. I-88, 89; and Fertiliser News, Vol. 21, No. 6, June 1976.

Targets and Achievements of Domestic Production of Fertilisers

Table 6 shows targets and achievements with respect to creation of installed capacity in different Five Year Plans. Except the First Five Year Plan, the targets of installed capacity laid down in different five Year Plans have remained unachieved. The performance in achieving the targets of production has been even poorer.

Fertiliser production targets of the Five Year Plans remained substantially unachieved not only because of the shortfall in achieving targets of installed capacity but also because of the substantial underutilisation of installed capacity. In a situation where a number of new plants are coming up, some underutilisation of installed capacity is common because of the start-up problems. Notwithstanding this, the available evidence shows that in many fertiliser factories, there has been chronic underutilisation of installed capacity.[15] This has been due to varied reasons such as interruptions in the supply of imported raw materials, power cuts, frequent labour troubles, and operational difficulties arising from factors such as high ash content in lignite, poor quality of gypsum, lower than desirable quality of refinery gas, and inadequate supply of coke-oven gas.

The Oil Crisis has further compounded the difficulties with respect to raw materials and feedstocks required for the domestic

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[15] See Trilochansingh, "Coal – The Old Newcomer," Fertiliser News, Vol. 19, No. 4, April, 1974; "Productivity in the Indian Fertiliser Industry," Fertiliser News, Vol. 20, No. 3, March 1975, and various issues of Fertiliser Statistics, published annually by Fertiliser Association of India.

Table 6 : Targets and Achievements of Domestic Production of Fertilisers in Different Five Year Plans

	I Plan	II Plan	III Plan	IV Plan	Draft V Plan
			000 Tonnes of Nutrients[a]		
Installed Capacity					
Capacity at the beginning	36	138	305	822[b]	2498
Target of capacity	127	502	1500	4200[c]	7715[d]
Capacity actually installed	138	305	822	2498	3504[e]
Percentage of target achieved	109	61	55	59	45[f]
Production					
Production at the beginning	20	89	166	357[b]	1374
Target of production	123	410	1200	3400[c]	5250[g]
Production in the last	89	166	357	1374	1828[f]
Percentage of target achieved	92	40	30	40	35[f]

a $N + P_2O_5$. There is no domestic production of K_2O in India.

b In 1965-66

c In 1973-74

d 6030 in the final version of Fifth Five Year Plan.

e Installed capacity in production as on December 1, 1975. In addition to this, capacity amounting to 2.36 million tonnes was under implementation, 2.35 million tonnes was approved in principle, and 228,000 tonnes was proposed.

f By 1975-76.

g 3670 in the final version of the Fifth Five Year Plan.

Sources: Compiled from Fertiliser Association of India, A Study on Fertiliser Demand and Marketing, Vol. III, (New Delhi, 1974), Chapter 2, and Fertiliser Statistics, 1974-75, (New Delhi, 1975), pp. I-88, 89; Government of India, Planning Commission, Draft Fifth Five Year Plan 1974-79, Vol. II, (New Delhi, 1974), and Fifth Five Year Plan, 1974-79, (New Delhi, 1976).

fertiliser industry. This is because bulk of the materials such as rock phosphate, sulphur and naphtha are imported. Naphtha accounted for about three-fourths of the feedstocks for the factories in production in 1975. In view of the limited domestic supplies of naphtha, a number of factories under construction, aim at using fuel oil as feedstock. In the long-run, however, coal might be the answer to the requirements of feedstocks for the domestic fertiliser industry.

The difficulties of enlarging the availability of fertilisers were not confined only to domestic production. Because of the scarcity of foreign exchange and fluctuating availability of fertilisers in the world market, imports of fertilisers were constrained by a number of factors such as foreign aid and bilateral trade agreements, availability of the type of fertiliser required, prices of fertilisers, and ease and cost of shipping.

The dominance of imports in total availability of fertilisers, repeated shortfalls in achieving the planned targets of fertiliser production, the difficulties of enlarging availability of fertilisers described above, and occasional emergence of pockets of scarcity have created a general impression that inadequate supply of fertiliser has been constraining the trends in the growth of its use. How correct is this impression?

Availability and Growth of Fertiliser Consumption

If time-series data on domestic production, imports, carryover stocks and consumption of fertilisers were available,

t would not be difficu. to check if the trends in fertiliser consumption were adversely affected by inadequate availability of fertiliser. A complete set of such data, however, are not available. While time-series on production and imports are available for 1952-53 to 1975-76, the consumption data are available only from 1967-68 to 1975-76. Worse still, the data on stocks are available only for a couple of years, and that too for only nitrogenous fertilisers. Therefore, we have examined the question of whether availability was constraining the past trends in growth of fertiliser consumption in two different ways.

Even a casual glance at Figure 1 reveals distinctly different patterns in the trends of fertiliser production and imports. Excepting two years, there was continuous growth in domestic production of fertilisers, particularly after 1958-59. Against this, the imports grew from about 50,000 tonnes in 1958-59 to about 375,000 tonnes in 1964-65 but in a fluctuating manner. Then they rose sharply for three consecutive years, and reached 1.6 million tonnes in 1967-68. This was followed by a continuous sharp decline to 633,000 tonnes in 1970-71. In the subsequent four years they again rose sharply, and regained the 1967-68 level of 1.6 million tonnes in 1974-75. In 1975-76, they were marginally lower at 1.54 million tonnes.

From the above patterns in the trends of production and imports, and also because of the importance of imports in total

availability, one would expect the trends in consumption to have a similar pattern as the one in the trends of imports. This would be particularly true if inadequate availability due to decline in imports was constraining the trends in the growth of fertiliser consumption. But, as figure 1 shows, there is no such similarity between the trends of imports and those of consumption. In fact, the figure clearly shows that between 1967-68 and 1970-71 there was continuous rapid growth in fertiliser consumption despite sharp and continuous decline in imports. That the growth in consumption during this period could not have been faster, if there was no decline in imports, is indicated by huge carryover stocks of fertilisers during this period, as discussed below. Thus, it is clear that the availability of fertilisers was not restricting the trends in the growth of fertiliser consumption. This conclusion is further supported by the following analysis.

On the basis of the limited available information on carryover stocks of nitrogen, we have made estimates of annual availability and consumption of nitrogen from 1961-62 to 1975-76. These estimates are shown in Table 7. The most striking point in Table 7 is that in many years between 1961-62 and 1975-76, a fairly high percentage of the available fertilisers remained unutilised. Due to the seasonality in fertiliser demand and various difficulties in moving fertilisers from sources of supply to consuming points, one could not expect a complete utilisation of all available fertilisers during any year. But the table

7 : Availability and Consumption of Nitrogen, 1961-62 to 1975-76

Year	Opening Stocks	Domestic Production	Imports	Total Availability	Consumption	Closing Stocks	Closing Stocks as % of Availability
			000 Tonnes of Nitrogen				
1961-62	58	154	143	355	250	105	30
1962-63	105	194	230	529	333	196	37
1963-64	196	219	198	613	377	236	38
1964-65	236	243	256	735	555	180	24
1965-66	180	238	376	794	673	121	15
1966-67	121	309	575	1004	737	267	27
1967-68	267	403	976	1646	833	812	49
1968-69	812	563	780	2155	1169	986	46
1969-70	986	731	574	2291	1378	913	40
1970-71	913	832	482	2227	1487	740	33
1971-72	740	949	463	2152	1776	375	17
1972-73	375	1055	691	2121	1810	311	15
1973-74	311	1050	661	2022	1829	193	10
1974-75	193	1186	885	2264	1774	490	22
1975-76	490	1508	951	2949	2120	829	28

Note : 1. Data on domestic production and imports are available for all years. However, data on opening stocks, consumption and closing stocks are available only for some of the years. For the remaining years these variables, and for all years availability are estimated as follows:

i. Availability = Opening Stocks + Domestic Production + Imports
ii. Opening Stocks in any Year = Closing Stocks in the Previous Year
iii. Consumption = Availability - Closing Stocks.

2. The consumption data for 1967-68 to 1974-75 includes nitrogen distributed to Tea Board, Coffee Board, Rubber Board, UPASI, and Cardamom Board.

Tab'a 7 contd ...

Sources :

1 Government of India, Ministry of Food & Agriculture, Report of the Committee on Fertilisers, (New Delhi, 1965), pp. 148, 149, 154.

2 Fertiliser Association of India, Report of the Credit Committee of the Fertiliser Association of India, (New Delhi, 1968), p. 330

3 Fertiliser Association of India, Fertiliser Statistics, 1974-75, FAI, (New Delhi, 1975), pp. I 88,89.

4 Fertiliser Association of India Production and Consumption of Fertilisers: Annual Review, 1975-76, FAI, (New Delhi, 1976), Table 8, T 11.

5 Fertiliser Association of India Fertiliser Marketing News, Vol. 7(3), March 1976, p. 2.

6 Fertiliser Association of India, Fertiliser Marketing News, Vol. 7(5), May 1976, p. 15

shows that in 9 out of 15 years, as much as over one-fourth of the available fertilisers remained unutilised. In fact, following the practice of the fertiliser industry, if we assume that only 10 per cent of the aggregate consumption is required in the pipelines, then it is clear that there was not a single year during 1961-62 to 1975-76 when the aggregate consumption level could have suffered adversely due to inadequate overall availability.

The above conclusion is not consistent with the general impression that during 1972-73 and 1973-74 there was scarcity of fertilisers. As Table 7 shows these were years of tight overall availability. Due to various inefficacies in the distribution system, discussed in the next section, pockets of scarcity did develop during these years. But it would be incorrect to conclude from such exceptional situations that inadequate overall availability of fertiliser was restricting the trends in the growth of total fertiliser consumption.

Table 7 also reveals that tight availability of fertilisers during 1972-73 and 1973-74 was mainly due to a sharp fall in opening stocks from over 900,00 tonnes in 1969-70 and 1970-71 to below 400,000 tonnes in 1972-73 and 1973-74. This, in turn, was mainly due to a sharp and continuous reduction in imports from 1967-68 to 1971-72. Inasmuch as this was in response to huge carryover of stocks for four consecutive years, it could be argued that during the last ten years or so, the import component

of fertiliser availability has been influenced by trends in consumption and not vice versa.

The main thrust of the above analysis is not that the trends in availability of fertilisers are not relevant to understand the trends in fertiliser consumption. That would be absurd. Similarly, the above analysis also does not imply that adequate availability of fertilisers at the macro-level ipso-facto imply adequate and timely availability at the micro-level. For a country as vast as India this too would be absurd. What the analysis stresses, however, are the following three points. First, notwithstanding the various difficulties in enlarging availability of fertilisers, it would be incorrect to say that aggregate availability has restricted the trends in the growth of fertiliser consumption. Second, it would be rather naive to assume a one-way cause and effect relationship between availability and consumption of fertilisers, and thus attribute the poor trends in consumption during 1970s to relatively tight availability of fertilisers. Third, the main explanation behind the past trends in fertiliser consumption lies in areas other than those related to aggregate availability of fertilisers.

Section IV

Distribution of Fertilisers

Importance of Distribution System

Bulk of agricultural inputs in developing countries are produced within the agriculture sector itself. Consequently, distribution systems for such modern inputs as fertilisers, pesticides and farm machinery are non-existent. More importantly, adequate and efficient distribution systems for these inputs seldom rapidly come into existence on their own because of low volume of business and lack of infrastructure facilities such as roads and warehouses. In India, issues related to distribution systems assume further importance because of the stupendous task of serving over 50 million operational holdings located in nearly 600,000 villages which are distributed over a geographical area of nearly 33 million square kilometers.

Contextual Background

Until 1943 fertiliser use was confined to plantations and some areas growing sugarcane and rice. Fertiliser distribution was entirely with private firms engaged in its production and imports. During this period, nearly 80 per cent of the small quantities of fertilisers used in the country were imported. The imports declined sharply as the War gathered momentum. On the other hand, the government decided to promote fertiliser use on

foodgrains through the GMF campaign to increase food production rapidly. Such circumstances, marked by scarcity of fertilisers, affected the evolution and development of fertiliser distribution system in India.

Distribution Arrangements at the Macro Level

During the war years, the limited amount of fertilisers available for exports in the surplus countries was allotted to various governments by the International Emergency Food Council. To import fertilisers allotted to India, in 1943 the Government established a Central Fertiliser Pool (CFP) in the Ministry of Food and Agriculture. Because of the scarcity of fertilisers in the country, besides importing, the Pool was to procure the entire quantity of fertilisers produced in the country to ensure equitable distribution of available fertilisers among different parts of the country at a uniform reasonable price. This macro arrangement of pooling imports and domestic production continued until late 1960s.[16] The arrangements, however, were restricted to nitrogenous fertilisers except from 1948 to 1952 when they were extended to phosphatic fertilisers as a result of protection sought by the domestic producers from the competing imports.

The Pool made estimates of requirements and domestic production each year, and worked out the needed amount of imports.

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[16] For a comprehensive review of the functions and performance of CFP, see B.P.Sikder, "Central Fertiliser Pool" in Fertiliser Marketing News, Vol. 7, No. 5, May 1976, pp. 1-5. Also, see Report of the Committee on Fertilisers, Government of India, Ministry of Food & Agriculture, (New Delhi, 1965), pp. 47-48, 136-134.

Domestic production and imports were then pooled together, and allocated among State Governments (representing non-plantation agriculture), plantation boards (representing tea, coffee and rubber plantations) and industrial users on the basis of their estimates of demand, past consumption trends, and overall availability. Besides controlling the distribution of entire quantity of fertiliser at the macro level, the Pool also fixed the prices at which fertilisers were to be sold to the cultivators.

Under such arrangements for distribution of fertilisers, was the growth of fertiliser consumption in some states adversely affected due to inadequate availability? The relevance of this question is indicated by the wide variation in growth patterns of fertiliser use upto 1964-65 among different states.[17] An analysis of the statewise carry-over stocks in each year between 1956-57 and 1964-65, however, clearly shows that poor growth in fertiliser use, particularly in states with low levels of use, was not due to inadequate availability of fertiliser.[18]

On the recommendation of the Committee on Fertilisers, in 1966 the Government of India decided to discontinue procurement of domestic production for centralised distribution, and to allow new fertiliser factories to market their products through agencies of their choice, in place of their choice, and at prices to be

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[17] Gunvant M. Desai, Growth of Fertiliser Use in Indian Agriculture, Past Trends and Future Demand, Occasional Paper No. 24, Department of Agricultural Economics, (Cornell University, Ithaca, New York, July 1969), pp. 91-95.

[18] Ibid., pp. 96-98

determined by them. It, however, reserved the right to take over 30 per cent of production for its own distribution at prices to be negotiated with the factories. Such freedom was also to be extended to the existing factories in a phased manner. The Central Fertiliser Pool was to confine its operations only to imported fertilisers.

There were four main reasons for the above change in distribution arrangements: (i) to attract private, especially foreign, investment in domestic fertiliser industry, (ii) to ensure that manufacturers' decisions to invest in fertiliser production were based on their confidence in finding buyers for their products, (iii) to bring agencies other than cooperatives into the distribution networks, and (iv) to develop competitive market structure.[19]

The liberal policy of fertiliser distribution came into full operation during late 1960s. This was a period of easy availability of fertilisers as shown in Table 7. The situation, however, changed in 1970s. To cope with the relatively tight availability of fertilisers, and to ensure their equitable distribution among regions, the government used the powers it had under

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[19] Government of India, Ministry of Food and Agriculture, Report of the Committee on Fertilisers, (New Delhi, 1965), Chapter VI.

the Essential Commodities Act(ECA).[20]

The notification issued by the Government of India on July 1, 1972 enabled it to direct fertiliser manufacturers to supply specified quantities of fertilisers to specific states during a specified period. To enforce this regulation, state-wise supply plans are being issued at the end of each biannual zonal conference. These conferences assess the requirements of each state, union territory and commodity board for Kharif and rabi seasons. They are attended by the representatives of the Government of India, state governments, union territories, commodity boards, fertiliser manufacturers and fertiliser Association of India. After taking into account carry-over stocks and domestic availability of fertilisers as per commitments of manufacturers, the quantum of supply by the Central Fertiliser Pool out of imports is also assessed in these conferences.

It is thus clear that though formal procurement of all domestically produced fertiliser has stopped after late 1960s,

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[20] The ECA, passed on April 1, 1955 gave the government sweeping powers to provide for the control of production, supply and distribution of, and trade and commerce in essential commodities in the interest of general public. Fertiliser was covered by this Act on March 29, 1957. This enabled the government to exercise various powers available under ECA by promulgating the Fertiliser Control Order (FCO) on April 23, 1957. The order was a comprehensive set of instructions regulating production, distribution, sale, prices and quality of fertilisers. By amending it through notifications, the government regulated fertiliser distribution system to suit the changing conditions. For details see Fertiliser Association of India, Handbook on Fertiliser Marketing, (New Delhi, 1976), pp. 148-157.

the distribution of fertiliser among states is still very much determined by the government.

Due to non-availability of statewise data on carry-over stocks of fertilisers, it is difficult to determine if the above regulatory intervention has adversely affected the growth in fertiliser use after July 1972. One thing, however, seems certain. The distribution arrangements, evolved to cope with tight availability of fertilisers, could not be expected to generate adequate competitive pressure on domestic producers to develop expanding markets for fertilisers.

Agencies Involved in the Distribution System in States

After the establishment of the Central Fertiliser Pool, nitrogenous fertilisers allotted to various states by the Pool were handled by the State Departments of Agriculture. Initially, these fertilisers were channelled to the cultivators through government depots. This function, however, increasingly went to the cooperative institutions as a result of the recommendations made by the Famine Enquiry Commission (1945), the Second Food-grain Policy Committee (1947), the Planning Commission (1952), the National Cooperative Development and Warehousing Board (1957), the National Development Council (1958), the Nalagarh Committee on Agricultural Administration (1958), and the Working Group on Cooperative Policy (1959). By mid-1960s cooperatives had not only a predominant but a substantially monopolistic role in the

distribution system of nitrogenous fertilisers in many states.[21] In 1965, out of about 51,000 retail outlets of fertilisers, 70 per cent were in the cooperative sector, 18 per cent in the hands of private agencies and 4 per cent in the government system.[22]

As for phosphatic fertilisers, in certain states like Bihar, Madhya Pradesh, Orissa, Punjab and Rajasthan, bulk purchases were made by the state governments, and their distribution was entrusted to cooperatives. In other states, the distribution was organised by manufacturers through both cooperatives and private dealers. Potassic fertilisers were distributed by the Indian Potash Supply Agency through its agents.

Cooperatives were given a predominant role because of the accepted policy of the government to encourage these institutions. Their being the sole agency for institutional credit in rural areas also contributed to viewing them as the main distributors of

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[21] According to the Committee on Fertilisers, the distribution of nitrogenous fertilisers was entrusted to cooperative organisations on a monopolistic basis in Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Mysore, Orissa, Punjab, and Rajasthan. In Uttar Pradesh, distribution was through cooperatives as well as depots of the Agriculture Department. In Assam, it was entirely in the hands of private agencies while in Himachal Pradesh, Manipur, Tripura and the Andamans, it was entirely through government agencies (Report of the Committee on Fertilisers, Government of India, Ministry of Food & Agriculture, (New Delhi, 1965), p. 48

[22] S. Venkatappaiah, "Fertiliser Credit and Distribution: New Perspective and Old Problem," Seminar on Fertiliser Credit and Distribution, 1967, Proceedings, Fertiliser Association of India, (New Delhi, 1968), p. 25.

fertilisers. It was also believed that fertiliser distribution would give cooperatives monetary benefits. Finally, it was felt that cooperatives were the only channels to provide farm supplies in remote areas where other agencies were reluctant to open distribution outlets.

While in some states (Andhra Pradesh, Gujarat, Maharashtra and Punjab) the performance of cooperatives in fertiliser distribution was satisfactory, in a number of states it was far below the expectations. Commenting on this, the Committee on Fertilisers (1965) made the following observations:

> " The performance of cooperative agencies in fertiliser distribution has not been upto expectations in many areas for various reasons. On account of the lack of marketing experience of most of the Cooperative agencies and on account of inadequate distributive margins, fertiliser distribution has in many cases been a monetary drag on the Cooperative system. The volume of credit available from the cooperative sector was also as low as 30% of the total borrowings of rural households with the result that the Cooperative agencies could not effectively serve a large number of farmers outside the cooperative fold. Retail fertiliser agencies from the private trade generally have the advantage of their existing organisation so that they are able to manage with relatively smaller overhead charges and lower distribution margins. Cooperative depots, on the other hand, generally do not have the advantage of whole-time salesman. Cooperative depots do not also deal with other commodities in general. It would hardly be possible for a depot dealing solely in fertiliser to be self-supporting without an annual turnover of at least 200 tonnes of bagged fertilisers. Most of the cooperative depots have turnovers of much smaller quantities and it is unlikely that a large number of retail fertiliser depots in rural areas will be able to have such a large turnover in the next few years. The result has been that fertiliser distribution has proved unprofitable to many cooperative agencies. No cooperative can survive as a marketing organisation unless

it makes reasonable profit in the transaction."[23]

In its visits to the states, the Committee on Fertiliser also found that while the Agriculture Departments were in favour of indenting larger quantities of fertilisers, the tendency of the cooperative institutions was to limit the indents to lower figures.[24] On the basis of all these considerations, the Committee concluded that the cooperatives could not be asked to take responsibility for distributing a greater amount of fertiliser than what they felt could be effectively handled by them, and recommended a multi-agency approach for the fertiliser distribution system.[25]

When the domestic fertiliser producers were given freedom to market their own products in late 1960s, there was toning down of the emphasis on distribution of fertilisers through cooperatives. As a result of this change in the policy, manufacturers started developing their own distribution channels, and the dominance of cooperatives in the distribution system started declining. In 1975, cooperatives and other institutional agencies accounted for about 40 per cent of the outlets for fertilisers against about 82 per cent in 1965. The share of private agencies in total outlets increased from about 18 to 60 per cent during

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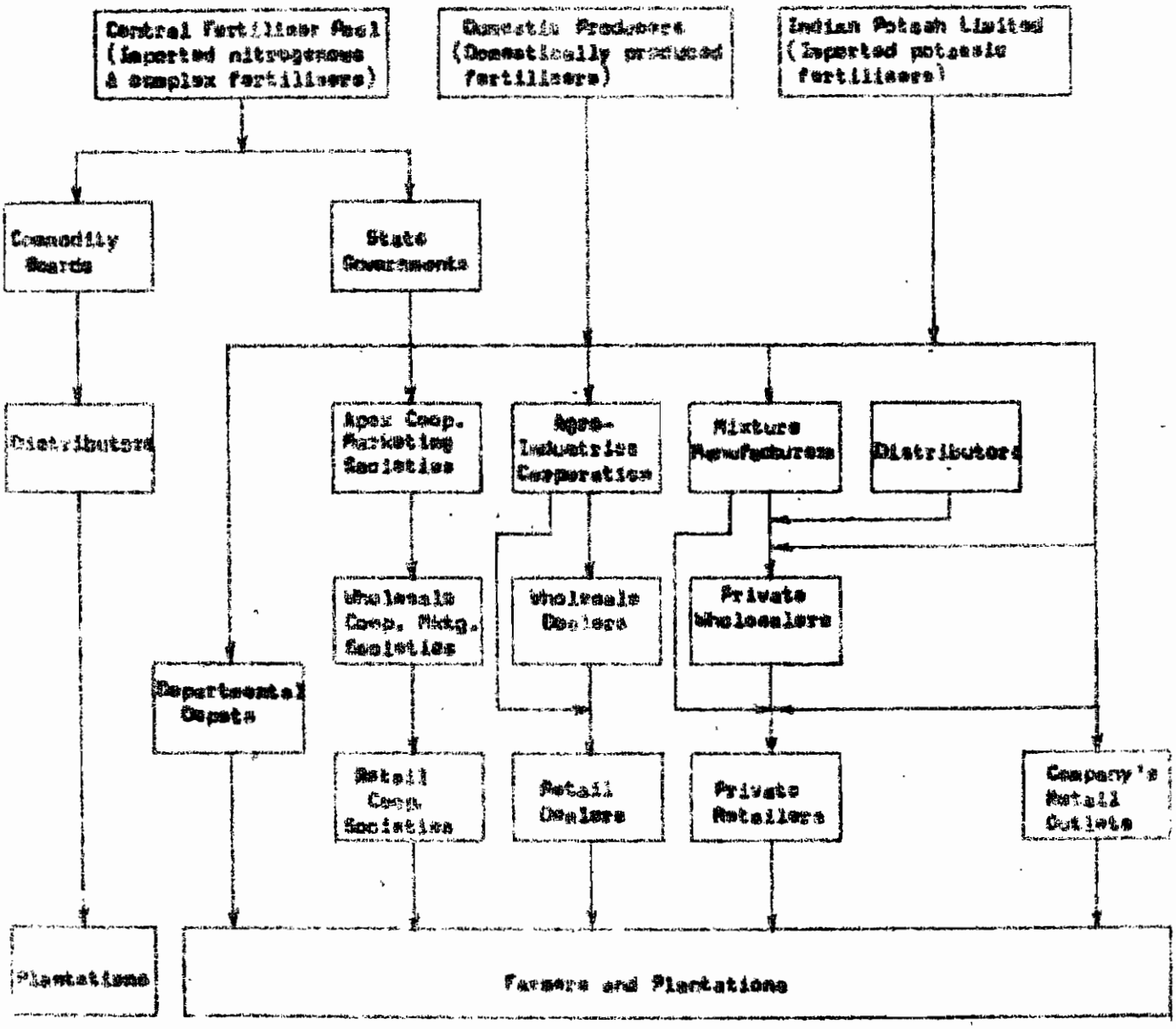
[23] Report of the Committee on Fertilisers, Government of India, Ministry of Food & Agriculture, (New Delhi, 1965), pp. 49-50.

[24] Ibid., p. 51

[25] Ibid., p. 51

the same period.[26] Figure 2 shows the fertiliser distribution system which has now come into existence.

Figure 2 : Fertiliser Distribution System



[26] Fertiliser Statistics, 1974-75, Fertiliser Association of India, (New Delhi, 1975), pp. 1-119.

Number of outlets

Though historical data on outlets for fertiliser distribution are scanty and not strictly comparable, it is clear from Table 8 that after 1960 there was a rapid growth in the number of outlets. Consequently, the average number of villages served per outlet declined from about 25 in 1959-60 to about 6 in 1974-75. Till mid-1960s, the expansion in distribution outlets was mainly due to the increase in the number of cooperative societies which took up fertiliser distribution. From late 1960s, the increase in the number of outlets was mainly due to the involvement of private agencies and domestic producers in fertiliser distribution.

Though substantial, the past growth is inadequate. There is a vast variation in the number of villages covered per outlet in different parts of the country. As shown in Table 9, even in 1974-75, in about half the states, there was only one outlet per 10 or more villages. The importance of cooperatives and other institutional outlets in total outlets, differs from less than 10 per cent in Bihar and West Bengal to over 75 per cent in Punjab, Haryana and Jammu and Kashmir. Nor were the distribution outlets expanding at comparable rates in all states.

The above features leads one to ask if there was any systematic association between intensity of coverage by distribution networks on the one hand, and levels and growth of fertiliser use in different states on the other hand.

Table 8 : Growth in Distribution Outlets for Fertiliser, 1959-60 to 1974-75

Year	Total Number of outlets	Average Number of Villages Served per outlet
1959-60	23,588	24
1964-65	60,725	9
1968-69	56,576	9
1970-71	81,460	7
1974-75	98,629	6

Sources : 1959-60 : Report of the Fertiliser Distribution Enquiry Committee, Government of India, Ministry of Food and Agriculture, (New Delhi,1960), pp. 24-25

1964-65 : Report of the Committee on Fertilisers, Government of India, Ministry of Food & Agriculture, (New Delhi, 1965), p. 192

Other Years: Relevant Volumes of Fertiliser Statistics, Fertiliser Association of India, New Delhi.

Table 9 : Regional Variation in Distribution Outlets, 1974-75

Zone/State	No. of villages per outlet	Institutional outlets as percentage of total outlets	Annual compound growth rate of outlets between 1968-69 & 1974-75
Central			
Madhya Pradesh	14	67	12.2
Rajasthan	14	52	- 2.5
Uttar Pradesh	9	47	9.0
Delhi	11	27	NA
East			
Bihar	18	7	1.2
Orissa	11	49	- 2.2
West Bengal	2	5	15.0
Assam	25	24	NA
Manipur	14	37[a]	NA
Tripura	22	NA	NA
North			
Jammu & Kashmir	6	100[a]	5.1
Himachal Pradesh	10	86	- 1.8
Punjab	-	70	5.7
Haryana	3	62	0.2
West			
Gujarat	3	73	7.5
Maharashtra	14	48	- 4.2
South			
Andhra Pradesh	3	16	14.9
Karnataka	4	63	13.0
Tamil Nadu	1	32	3.2
Kerala	b	49	3.4
All India	6	40	6.0

a Relates to 1973-74

b Less than 0.5 villages

Source: Derived from FAI, Fertiliser Statistics, 1974-75, p.I-119, II-47; Fertiliser Statistics, 1971-72, p.247; and FAI, A Study on Fertiliser Demand and Marketing, Vol. II, Part VII (Orissa), Fertiliser Association of India, New Delhi, p. 39; A Study on Fertiliser Demand & Marketing, Vol.II, Part XIII(U.P.),pp.47-49

Regional Variation in Distribution Outlets and Fertiliser Use

To answer the above question, Spearman's rank correlation coefficients are estimated using statewise data for the period between 1968-69 and 1974-75. The results of this analysis are presented in Table 10 and discussed below.

As one would expect, there is a high and positive association between level of fertiliser use and intensity of coverage by distribution outlets -- the rank correlation coefficient is 0.75, and it is significant at 1 per cent level. On the other hand, there is no significant association between level of fertiliser consumption and the importance of institutional outlets in the distribution networks.

Despite the highly significant positive association between level of fertiliser use and the intensity of coverage by distribution outlets, it would be incorrect to say that the variation in the growth rates of fertiliser consumption among states was due to the variation in the intensity of coverage by the distribution outlets. The rank correlation coefficient between these two variables is 0.04 and not significant. Nor was the growth rate in fertiliser consumption during 1968-69 to 1974-75 significantly associated with the expansion in the distribution outlets during the same period -- rank correlation coefficient 0.03, and not significant.

The above conclusion may appear surprising. But it is necessary to recognise that the expansion in distribution out-

Table 10 : Association between Regional Variation in Coverage by Distribution Outlets and Levels and Growth of Fertiliser Use

	Spearman's Rank Correlation Coefficient
1. Per hectare use and Intensity of Coverage[a]	
a. 1968–69	+ 0.75[x]
b. 1974–75	+ 0.75[x]
2. Per hectare use and Percentage of institutional outlets in the total number of outlets	
a. 1968–69	– 0.16
b. 1974–75	– 0.25
3. Intensity of coverage in 1968–69 and Growth in use during 1968–69 to 1974–75[b]	+ 0.04
4. Change in the intensity of coverage between 1968–69 and 1974–75 and Growth in use during 1968–69 to 1974–75	+ 0.03

a Average number of villages served by one distribution outlet

b Average annual increase in use per hectare

x Significant at 1 per cent

lets takes place either <u>to create</u> additional demand or mainly <u>to facilitate</u> consumption resulting from growth in demand. In the latter case, demand grows as a result of forces other than the efforts of the distribution system. In India, by and large, so far the expansion in distribution outlets seems to have taken place to facilitate the growth in demand rather than to create additional demand. This conclusion is consistent with insignificant involvement of the distribution system in the demand creation activity. It is also consistent with the fact that most of the past growth in the distribution outlets has not been due to pressure on the supply system, particularly domestic production system, to create additional demand. Instead, it has been either due to the policy of involving cooperatives in the distribution of fertilisers or in response to rapidly growing effective demand for fertilisers in certain pockets where the use of this input was highly profitable to cultivators.[27]

Yet another set of reasons why the distribution system has not been able to play a decisive positive role in the past growth of fertiliser use are its various problems and limitations discussed below.

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[27] This is not to argue that the pressure on the supply system did not develop at any time to expand the distribution outlets to create additional demand for fertilisers. In fact, such pressure did develop in the late 1960s because of huge carry-over stocks of fertilisers. But it disappeared very soon due to tight availability of fertiliser resulting from the reduction in imports (Table 7).

Problems and Limitations of the Fertiliser Distribution System

A study based on a sample of 2,000 fertiliser dealers, conducted by the Fertiliser Association of India (FAI), throws light on many features of the fertiliser distribution system.[28] Various findings of this study reveal the following major problems in the system: (i) seasonality in fertiliser trade coupled with low volume of business for many retail outlets[29], (ii) low margins per unit of turnover, (iii) insufficiency of credit availability both to purchase and sell fertilisers, (iv) procedural delays in the timely availability of credit, (v) frequent transport bottlenecks due to non-availability of rail wagons and road vehicles in time, (vi) high transportation cost, particularly for movement to interior regions, (vii) inadequate storage facilities particularly in the interior markets, (viii) non-availability of fertilisers in time at the outlets due to some of the above reason, and also due to lack of efficient and well-coordinated indenting procedures and forward planning by principals, (ix) dilatory licensing procedures, and (x) compulsory requirements to stock phosphatic and potassic fertilisers with nitrogenous fertilisers even in the absence of adequate demand for such fertilisers.

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[28] Fertiliser Association of India, A Study on Fertiliser Demand and Marketing, Fertiliser Distribution and Marketing Facilities, Vol. II, All India Summary Report, (New Delhi, 1974). The study is based on data which relate to 1967-68, 1968-69 & 1969-70.

[29] Even as late as 1974-75, the average volume of business per outlet works out at 26 tonnes of NPK. In as many as 12 states, this was lower than the national average, and in 5 states it was less than even 10 tonnes.

Because of the above problems, the working of the distribution system has not been satisfactory. For instance, in a study conducted by Fertilisers and Chemicals Travancore Ltd., in Karnataka it was found that none of the 120 wholesalers in the sample was interested in advance stocking, and all of them expected the manufacturer to stock at convenient locations in advance of season and supply them during the season.[30] Similarly, there is a reluctance to develop supply lines in the interior markets. It has also been repeatedly observed that there is hardly any effective promotional efforts by fertiliser dealers, and almost entire burden of promotional efforts has been on the government system till very recently.

A number of micro studies, conducted during late 1960s and early 1970s, also report certain shortcomings of the distribution system from the cultivators' viewpoint.[31] Four shortcomings which were identified repeatedly were: (i) inadequacy of supplies at consuming points, (ii) delay in supplies, (iii) prevalence of higher than controlled prices, and (iv) inadequate

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[30] K. Pushparaj, "Establishing an Effective Dealer Organization," in Seminar on Fertiliser Marketing, 1968, Fertiliser Association of India, (New Delhi, 1969), pp. 103-104.

[31] For details see, various papers submitted to the 1973 Annual Conference of the Indian Society of Agricultural Economics on "Agricultural Input Supply Systems Including Marketing" as well as the Rapporteur's Report on these papers in Indian Journal of Agricultural Economics, Vol. XXVIII, No. 4, Oct-Dec., 1973, pp. 68-172.

number of sale points. It is worth noting that all 'black' market situations were not characterised by supplies of the three nutrients being less than demand for them. Cultivators' preference for specific fertilisers, and delays in supplies from government and cooperative institutions seemed mainly responsible for private dealers charging higher than the controlled prices.

Distribution System and Fertiliser Consumption During 1970s

The various problems and shortcomings of the distribution system discussed above explain why it did not play a decisive positive role in the past growth of fertiliser use. Could the virtual stagnation in fertiliser consumption between 1971-72 to 1974-75 be attributed to them? In our view it would be erroneous to do so.

As the above analysis shows, fertiliser distribution system in India emerged and got developed primarily to facilitate growth in demand for fertilisers as distinguished from creating additional demand for fertilisers. Viewed thus, one is justified in attributing the stagnation in fertiliser consumption to the shortcomings of the distribution system if these shortcomings became more acute during 1970s. But there was no deterioration in the distribution system during this period. In fact, there were several improvements such as growth in the number of outlets, diversification in the agencies involved, emergence of commercial banks to provide credit for fertilisers,

and increasing involvement of the domestic fertiliser producers in developing the distribution system. Even the macro distribution arrangements under the Essential Commodities Act could not be considered inferior to the full-fledged pooling system which prevailed till late 1960s. Thus, it would be illogical to blame the shortcomings of the distribution system for the stagnation in fertiliser consumption trends during 1971-72 to 1974-75.

Section V

Demand for Fertilisers

The main conclusion of the previous two sections is that one cannot adequately explain the forces behind the past trends in fertiliser use by examining either the availability or the distribution system of fertilisers. By implication, such a conclusion indicates the importance of demand in determining the past growth of fertiliser use. This is not surprising. Though availability and distribution arrangements are important, eventually growth in consumption occures as a result of growth in cultivators' effective demand for fertilisers.

A Conceptual Framework to Analyse Growth in Demand

To analyse the growth in fertiliser use from the viewpoint of cultivators' demand for this input, it is necessary to understand factors which affect cultivators' demand for fertilisers, and forces which govern growth in it.

Fertiliser being an input, an individual cultivator's demand for fertiliser is governed by returns from fertiliser use. The returns, on a particular crop, depends on (i) physical response of the crop to fertiliser use, (ii) price of the crop output, and (iii) cost of using fertiliser. At optimum rate, these returns are maximum. Therefore, if a cultivator knows the above three factors with certainty, he would demand the optimum amount of fertilisers. However, at the time of deciding fertiliser use, a cultivator does not know with certainty either the physical response of crop to fertiliser use or the price of output. Hence, his decision on fertiliser use is governed by <u>expected</u> response of crop to fertiliser use and <u>expected</u> price of crop output. Thus, there is a need to distinguish between <u>optimum (or potential)</u> demand on the one hand and <u>effective</u> demand on the other hand. While the former is affected by physical response function and prices of crops and fertilisers, the latter is also affected behavioural characteristics of the cultivators.

Viewed thus, for a given set of values of (i) physical response of different crops to fertiliser use under varied conditions, (ii) prices of different crops and (iii) cost of using fertiliser, conceptually there is a level of total <u>potential</u> demand for fertiliser. This level remains constant till the values of the above three parameters remain unchanged.

The effective demand for fertilisers depends on three decisions of cultivators: (i) whether to use fertiliser, (ii) on

which crops to use it, and (iii) at what rates to use it. To understand effective demand, it is important to differentiate these decisions. Fertiliser is a divisable input. Hence, there is no a priori reason why a cultivator adopting fertiliser automatically uses it on all or even most of the crops he grows. In fact, because returns from fertiliser use differ among crops, there is every reason to separate the first two decisions. Available evidence clearly shows that cultivators seldom fertilise more than one crop when they adopt fertiliser use, and do not fertilise all crops they grow even after a number of years from the first adoption.[32] Similarly, because of cultivators' ignorance about the precise nature of fertiliser response functions, and also because of the role of expectations with respect to response of crops to fertiliser use and crop prices, there is no reason to assume that a cultivator fertilises a crop at a normative rate recommended to him.

In a situation where fertiliser use is new, the total effective demand for fertiliser would be substantially lower than the total potential demand because not many cultivators know about returns from fertiliser use. Over time, however, the effective demand grows as the knowledge about returns from fertiliser use spreads among cultivators due to such factors as the experience of early adopters, and extension as well as pro-

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[32] Gunvant M. Desai, P.N.Chary, and S.C.Bandyopadhyay, Dynamics of Growth in Fertiliser Use at Micro Level, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad, 1973 (Mimeographed).

motional efforts of agencies concerned with increasing fertiliser use.[33]

Viewed in the context of the three decisions of cultivators, three forces generate growth in effective demand over time. These are: (i) adoption of fertiliser by an increasing number of cultivators, (ii) diffusion of fertiliser use on "other" crops grown by cultivators who have already adopted its use on some crop(s), and (iii) increase in the rate of application. So long as the total effective demand is less than the potential demand, these forces generate growth in effective demand even without any change in physical reponse of crops to fertiliser use, crop prices, and cost of using fertilisers.

In the real world, the values of the above three parameters seldom remain constant over time. What will be the impact of the changes in the values of the three parameters on potential demand as well as growth in effective demand for fertilisers?

Any change in the values of the three parameters which raises the level of potential demand will also accelerate the growth in effective demand for fertilisers. To illustrate, an increase in the physical response of crops to fertiliser use as a result of irrigation development or introduction of high yielding varieties will raise the level of potential demand if there are no offsetting changes in the prices of crops and cost of

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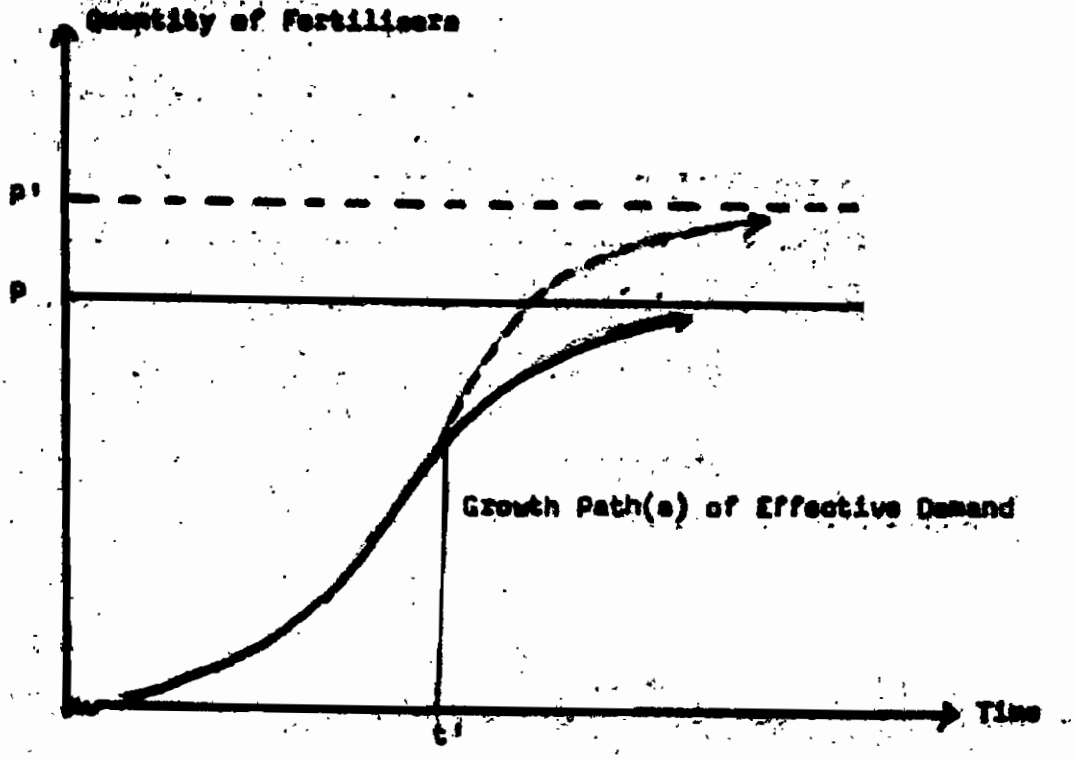
[33] For the role on promotional efforts in generating growth in effective demand, see Gunvant M. Desai, "Measuring Promotional Effectiveness," Fertiliser News, Vol. 20, No. 4, April 1975, pp. 3-8.

using fertilisers. Similarly, other things remaining the same, increase in crop prices (or decrease in the cost of using fertiliser) will raise the level of potential demand. Since such changes in the values of the three parameters raise returns to fertiliser use, they also accelerate growth in effective demand for fertilisers. This is shown diagrammatically in Figure 3.

Figure 3 : Growth in Demand for Fertiliser



Q = Original potential demand

Q' = Upward shift in potential demand due to favourable changes in parameters behind demand at time t'

The above conceptual framework provides two major insights to understand the growth in fertiliser use from the view point of cultivators' effective demand for this input.

First, cultivators' effective demand for fertiliser depends on the size and certainty of returns they expect from fertiliser use. Since these returns differ for different crops as well as under different situations (as such irrigated and unirrigated conditions) fertiliser use is likely to begin and spread more rapidly on crops, and in situations, where the returns are relatively higher and more certain. Thus, in a growth pattern governed by effective demand for fertilisers, cross sectional variations in the levels of fertiliser use, and concentration of use on some crops and in certain locations seem inevitable. One could also argue that distribution network would emerge and expand in such locations because of the pull of effective demand.

Second, so long as the effective demand is below the level of the potential demand in the above situations, total fertiliser use would continue to grow over time irrespective of whether values of three parameters governing returns from fertiliser use are changing significantly to raise these returns. However, as effective demand starts approaching the level of potential demand in situations where the use is concentrated, the growth of effective demand would slow down unless at least one of the two things happen. These are (i) changes in the

values of the three parameters which raise the level of potential demand in situations where the use is concentrated or (ii) pressures from the supply side result in activating potential demand in other regions through vigorous promotional efforts.

There are a number of features of the past growth pattern in fertiliser use which are consistent with the above conceptual framework.

Use Pattern at the Farm Level

Various findings on fertiliser practices of samples of cultivators from different parts of the country show a consistent pattern during the last two decades.[34] Certain non-foodgrain fertiliser responsive commercial crops such as sugarcane, tobacco, potato and banana were most commonly fertilised. Rice was also as extensively fertilised as these crops, particularly in the Southern region. The spread of fertiliser use on wheat was not as extensive as on rice till the introduction of the HYVs. Other foodgrains such as jowar, bajra and ragi were fertilised to a much lesser extent. Among important non-foodgrain commercial crops, cotton was fertilised much less commonly than sugarcane and tobacco. Among oilseeds only groundnut was fertilised and that too much less commonly than any other crop. Fertiliser use on pulses was almost non-existent. On the same crop fertiliser use was more common under irrigated conditions

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[34] For details see Gunvant M. Desai, Growth of Fertiliser Use in Indian Agriculture, Past Trends and Future Needs, Department of Agricultural Economics, Cornell University, Ithaca, N.Y., 1969, Chapter IV.

as compared to unirrigated conditions. Similarly, high yielding varieties of a specific crop were more commonly fertilised than the local varieties of the same crop. These features of the relative spread of fertiliser use on different crops, irrigated vis-a-vis unirrigated conditions, and local vis-a-vis HYVs could be explained by varying levels of profitability of fertiliser use in situations.

Findings of a micro study provide some valuable information on the spread of fertiliser use on different crops over time.[35] Over 80 percent of the sample cultivators fertilised only one crop and none fertilised more than three crops in the year they adopted fertiliser use. While almost all adopters spread fertiliser use on some other crops over time, very few fertilised crops such as jowar, bajra, varagu and pulses even after a number of years from the first adoption of fertiliser use on selected crops.

The above findings are supported by the results of a large survey conducted by the National Council of Applied Economic Research for the Fertiliser Association of India[36]. Table 11 shows the relative spread of fertiliser use on different crops under different situations even as late as 1970-71.

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[35] Gunvant M. Desai, P.N.Chary, and S.C.Bandyopadhyay, Dynamics of Growth in Fertiliser Use at Micro Level, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad, 1973.

[36] The survey covered over 4,000 households located in over 250 villages from all parts of the country. The reference years for the survey were 1968-69, 1969-70, and 1970-71. For details see, National Council of Applied Economic Research and Fertiliser Association of India, Fertiliser Use on Selected Crops in India, (New Delhi, 1974).

Table 11 : Spread of Fertiliser Use on Different Crops, 1970-71

Crop		Irrigated Conditions	Unirrigated Conditions	Total
		Percentage of Area Fertilised		
Foodgrains				
Rice	HYV	85.8	94.1	87.8
	Non-HYV	55.4	31.1	38.9
	Total	64.8	35.6	47.0
Wheat	HYV	88.5	56.3	85.2
	Non-HYV	47.3	10.8	37.8
	Total	68.7	15.8	49.9
Jowar	HYV	97.2	80.5	87.1
	Non-HYV	29.6	10.1	13.1
	Total	38.8	13.1	17.4
Maize	HYV	95.0	38.6	91.5
	Non-HYV	41.4	4.6	21.1
	Total	47.3	4.8	25.0
Other Cereals		38.8	11.3	15.8
Pulses		15.1	2.7	5.3
Non-Foodgrains				
Sugarcane		NA	NA	83.1
Cotton		70.5	31.3	40.3
Oilseeds		34.9	29.4	30.5

Source : Derived from the data given in National Council of Applied Economic Research and the Fertiliser Association of India, Fertiliser Use on Selected Crops in India, (New Delhi, 1974).

The findings of the various micro-studies conducted during the last two decades also consistently show that the actual rates of fertiliser application were significantly below optimum as well as recommended rates.[37] Till mid-1960s, there was very little upward movement in the actual rates of application. This seems to have been due to the small size of marginal returns beyond 50 to 75 per cent of the optimum rates on the existing varieties of crops. The situation, however, changed with the introduction and spread of the fertiliser responsive high yielding varieties -- dramatically in the case of wheat, and significantly in the case of rice and bajara in certain locations.

Use Pattern among the Districts

Analysis of the districtwise fertiliser consumption data reveals that bulk of the past growth in fertiliser use was concentrated in some districts while a large majority of districts remained outside the mainstream of growth in the use of this input. To illustrate, as late as 1974-75, about 16 per cent of the 380 districts accounted for 50 per cent of total fertiliser consumption in the country, and a little over one-third of the total districts accounted for 80 per cent.[38] The 1974-75 pattern

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[37] For details see, Gunvant M. Desai, Op.cit., Chapter IV

[38] Fertiliser Association of India, Production and Consumption of Fertilisers, Annual Review, 1975-76, (New Delhi, 1976), pp. T. 48-53.

was not unique. In 1968-69 also, less than one-third of the total districts accounted for about 80 per cent of the total fertiliser consumption. Furthermore, these districts accounted for over 70 per cent of the fertilisers used in the country in any year between 1950-51 and 1968-69.[39] A large majority of the districts where growth in fertiliser use was concentrated are in Punjab, Haryana, U.P., Maharashtra, Andhra Pradesh, Kerala and Tamil Nadu. On the other hand, most of the districts with very little share in total fertiliser consumption are in Madhya Pradesh, Rajasthan, Assam, Bihar, Orissa and West Bengal.

As a result of the above pattern of fertiliser use among districts, growth rates of fertiliser use varied widely among districts. The variation in growth rates was mainly due to differences among districts with respect to (i) levels of irrigation, (ii) cropping patterns, and (iii) diffusion of HYVs. Most of the districts with high growth rates of fertiliser use were those with high levels of irrigation and vice versa. Notable exceptions to this pattern were of two types. First, there were some distri... with moderate levels of irrigation but relatively low growth rates of fertiliser use. This was primarily due to the problem of water-logging in such districts. Second, there were some districts with low levels of irrigation but relatively high growth rates of ferti-

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[39] Gunvant M. Desai, and Gurdev Singh, Growth of Fertiliser Use in Districts of India, Performance and Policy Implications, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad, 1973, pp. 26-29.

liser use. This was primarily due to the importance of such commercial crops as cotton, tobacco and groundnut in the cropping patterns of these districts. The impact of HYVs on growth of fertiliser use was mainly confined to districts with moderate to high levels of irrigation, and where wheat was the dominant cereal crop. Major exceptions to this pattern were districts of the Southern region with high levels of irrigation and rice as the dominant crop.

Price Environment and Past Growth in Fertiliser Use

Fertiliser being an input, demand for it is governed by returns from its use. These returns are governed by physical response of crops to fertiliser use, prices of crops and cost of using fertiliser. In what follows we have examined the past growth in fertiliser use in the context of the price environment.

Table 12 presents the index numbers of (i) fertiliser price, (ii) wholesale prices of agricultural commodities, (iii) ratio of fertiliser price to wholesale prices of agricultural commodities, and (iv) fertiliser consumption between 1961-62 and 1974-75.[40]

Between 1961-62 and 1974-75, fertiliser consumption increased over seven times, wholesale prices of agricultural commodities rose by over three times, and the price of fertiliser increased by less than three times. As a consequence of unequal increase in the prices

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[40] The analysis is based on index number of wholesale prices of agricultural commodities as the index number of farm harvest prices is not available. This, however, does not alter the argument as can be seen from the table given in the Appendix.

of agricultural commodities and fertiliser, the ratio of two prices remained below the 1961-62 level. This is stressed. Even in 1974-75 when fertiliser price shot up due to the Oil Crisis, the index number of the ratio of fertiliser price to prices of agricultural commodities was 13 per cent below what it was in 1961-62. Thus, it is clear that the period in which there was substantial growth in fertiliser use was a period of price environment favourable to cultivators. It would be, however, erroneous to conclude that the price environment was the main determinant of the trends in fertiliser consumption during the 14-year period. This would be so because of the following three points suggested by Table 12.

First, the index number of fertiliser price declined gradually from 100 to 90 between 1961-62 and 1964-65. Thereafter it increased, more or less continuously, to 150 in 1973-74, and then shot up to 274 in 1974-75. The dramatic increase in fertiliser price in 1974-75 was associated with a decline in the level of fertiliser consumption. But the highest growth rate in fertiliser consumption was attained, not between 1961-62 and 1964-65 when fertiliser price was continuously declining but, after mid-1960s when it increased steadily.

Second, the entire period of increase in the prices of agricultural commodities can be divided into three sub-periods: (i) from 1961-62 to 1967-68 when the index number went up from 100 to 167, (ii) from 1967-68 to 1971-72 when it increased from 167 to 188, and (iii) from 1971-72 to 1974-75 when it rose from 188 to 314. Again, bulk of the growth in fertiliser consumption was not between 1971-72 and 1974-75, when the prices of agricultural commodities increased

Table 12 : Index Numbers of Fertiliser Price, Wholesale Prices of Agricultural Commodities, Ratio of Index Number of Fertiliser Price to Index Number of Wholesale Prices of Agricultural Commodities, and Fertiliser Consumption, 1961-62 to 1974-75

Year	Index Numbers of			
	Fertiliser Price	Wholesale Price of Agricultural Commodity	(2) ÷ 3	Fertiliser Consumption
(1)	(2)	(3)	(4)	(5)
1961-62	100	100	100	100
1962-63	95	104	92	124
1963-64	93	110	84	149
1964-65	90	122	74	170
1965-66	97	132	74	197
1966-67	101	150	67	313
1967-68	119	167	71	304
1968-69	125	165	76	436
1969-70	129	172	75	518
1970-71	130	181	72	567
1971-72	125	188	66	689
1972-73	133	207	64	703
1973-74	150	254	59	739
1974-75	274	314	87	675

Note : The index number of fertiliser price is calculated by calculating average price of fertiliser. The average price is calculated by weighing prices of different fertilisers by their relative importance in the consumption pattern.

Source : Derived from Fertiliser Association of India, Fertiliser Statistics, 1974-75, FAI, (New Delhi, 1975), pp. I89-111; and India, Directorate of Economics & Statistics, Bulletin on Food Statistics, GOI, Ministry of Agriculture & Irrigation, (New Delhi, 1976), p. 148.

most rapidly, but during the earlier period, particularly between 1967-68 and 1971-72, when they were rising at a moderate rate.

Finally, Table 12 also shows that between 1961-62 and 1974-75 the years of rapid and substantial growth in fertiliser use were not the ones in which the index number of the ratio of fertiliser price to prices of agricultural commodities was declining. In fact, the table clearly shows that continuous and substantial decline in this index number till mid-1960s could not generate growth in fertiliser use at a pace comparable to the one during the second half of 1960s in which the ratio was more or less stable.

It is, thus, clear that changes in the prices of fertiliser or agricultural commodities or in the ratio of the two prices had very limited influence in determining the trends in the growth of fertiliser consumption during the period from 1961-62 to 1974-75. This conclusion is further supported by the features of the fertiliser use pattern at the farm level and among districts discussed above as well as by the findings of a number of micro-studies based on continuous cross-section data.[41]

Major Sources of the Past Growth in Fertiliser Use

Though changes in price environment had limited influence in determining the past growth in fertiliser use, it is clear that the past growth in fertiliser use was governed by the growth in

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[41] For details see, various papers submitted to the 1976 Annual Conference of the Indian Society of Agricultural Economics on "Impact of Increase in Input Prices on Profitability and Production," as well as the Rapporteur's Report on these papers in Indian Journal of Agricultural Economics, Vol. XXXI, No. 3, July-September, 1976, pp. 63-156

effective demand for this input. There were three distinct forces behind this growth, viz., (i) increasing number of cultivators adopting fertiliser use on one or two crops which were relatively more profitable to fertilise, (ii) diffusion of fertiliser use on other crops, and (iii) replacement of local varieties by HYVs. The first two forces contributed to the growth in effective demand for fertiliser by increasing fertilised area. The third force, operating in a price environment which was considerably more favourable to the cultivators than the one in 1950s, contributed by accelerating the first two processes, and raising the rates of fertiliser application. The extent to which these forces could generate sustained growth in effective demand for fertiliser, however, depended on the scope for and the strength of the play of the above three forces.

As the analysis of the past fertiliser use pattern reveals, the adoption-diffusion process was mainly confined to irrigated areas, and to such rainfed regions where commercial crops like cotton, groundnut, and tobacco dominated. Even in these locations, the diffusion process was working very slowly on many non-commercial crops grown under unirrigated conditions. Obviously, such an adoption-diffusion process would not have generated sustained and substantial growth in effective demand for fertiliser for very long. Available research indicates clearly that the growth in effective demand for fertiliser would have started slowing down in the second

half of 1960s.[42] Such an outcome was, however, prevented due to the introduction of HYVs after mid-1960s.

Initially the impact of HYVs on the growth in effective demand for fertiliser was substantial. It not only sustained the past rate of growth but stepped it up as shown in Table 4 in Section II. But such an impact was short-lived. The spread of HYVs was restricted mainly to irrigated areas, and there too, they spread rapidly only in the case of wheat (Table 13). As the diffusion of HYVs of wheat started reaching upper limits in regions where wheat is grown under good irrigated conditions, the acceleration in the growth of total effective demand for fertiliser started slackening off. There were two other reasons behind this phenomenon. First, the available HYVs of rice were not economically viable in many agro-climatic conditions, and hence, they could not spread as rapidly as the available HYVs of wheat.[43] Second,

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[42] Gunvant M. Desai, and John W. Mellor, "Changing Basis of Demand for Fertiliser," Economic and Political Weekly, Vol. IV, No. 39, Review of Agriculture, September 27, 1969, pp. A175-A187. For more details, see Gunvant M. Desai, Growth of Fertiliser Use in Indian Agriculture, Past Trends and Future Demand, Chap. VII.

[43] Gunvant M. Desai, "Some Observations on Economics of Cultivating High Yielding Varieties of Rice in India," a paper presented in the Rice Policy Conference organised by International Rice Research Institute (IRRI) in May 1971, and published in Viewpoints on Rice Policy, IRRI, Los Banos, 1972, and also in Artha Vikas, Vol. VII, No. 2, July 1971, pp. 1-19. Also see, Gunvant M. Desai, "The Impact of the New Rice Technology on Fertiliser Consumption," a paper presented in the Conference on Economic Consequences of New Rice Technology organised by IRRI in December, 1976.

there was no major breakthrough in HYVs for rainfed conditions where foodgrains other than rice and wheat are mainly grown.

The phenomenon of slackening off in the growth of effective demand for fertiliser began in the late 1960s.[44] It manifested itself fully in the first half of 1970s as can be seen from Table 4. The dismal growth in fertiliser use during this period has often been attributed to inadequate availability of fertiliser rather than slackening off in the growth of effective demand for fertiliser. But as the analysis in Section III reveals, the availability of fertiliser during this period was affected by the slackening off in the growth of demand during late 1960s. More importantly, the availability was really tight only during 1973-74.

Similarly, the trends in fertiliser consumption from 1974-75 should not be seen only in the background of the unprecedented rise in fertiliser prices resulting from the Oil Crisis. As already pointed out a part of the rise in fertiliser prices was offset by the rise in the prices of agricultural commodities. Besides, the fertiliser prices have been reduced a couple of times in the last two years. Therefore, it is crucial not to focus only on the changed price environment but to recognise the phenomenon of slackening off in the growth in effective demand which has been under way since late 1960s. This is particularly necessary to realize that, at the present stage, continuous and substantial growth in fertiliser consumption depends, not on marginal manipulations of

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[44] Gunvant M. Desai and Gurdev Singh, Op.cit., Chap. V.

the price environment, ..st many other vigorous policy measures.

Section VI

Summing Up

The main purpose of this section is to bring together major conclusions of the above sections, and draw attention to some important policy implications which emerge from the analysis.

Despite impressive growth in fertiliser use during the last 25 years, even its current level is insufficient to prevent further depletion of soil fertility. What underscores the need for continuous rapid growth in fertiliser use is the fact that intensive cultivation is the only strategy available to meet growing requirements of agricultural production. This is recognised by all, without any qualification.

Neither the past record of achieving the planned targets of fertiliser use, nor the trends in the growth of fertiliser consumption could be relied upon to attain even the scaled-down levels of fertiliser use laid down in the final version of the Fifth Plan. To attain these levels, fertiliser use must grow by over 600,000 tonnes every year upto 1983-84. Against this, even between 1967-68 and 1971-72, it increased by only 366,000 tonnes a year. What is more alarming is that between 1971-72 and 1975-76, the growth was only 68,000 tonnes a year. Thus, a stupendous task is ahead to generate unprecedented acceleration in the trends of fertiliser consumption. Clearly, to undertake this task, policies based on the correct understanding of the forces which have governed the

past growth are required.

The past growth in fertiliser use could be attributed to the efforts made by the government. These efforts originated from recognising the importance of fertiliser in rapidly raising the production of foodgrains. The efforts began in early 1960s with the Grow More Food Campaign, and continued in the Five Year Plans in the context of the deficit in domestic production of foodgrains.

The strategy to increase fertiliser use aimed at four things, viz., (i) increasing availability of fertilisers through imports and development of domestic fertiliser industry, (ii) controlling the distribution of available supplies among different regions and also between plantations and non-plantation agriculture, (iii) establishing and regulating distribution networks to make fertilisers available to cultivators, and (iv) making cultivators adopt fertiliser use through the agricultural extension machinery. Under the prevailing circumstances, characterised by the importance of decisions to invest in capital intensive fertiliser industry and allocate scarce foreign exchange to import fertiliser, continued importance of fertiliser imports, virtual non-existence of distribution outlets for agricultural inputs, and lack of cultivators' knowledge about fertiliser, the above concerns were in the right directions. Policies based on these concerns contributed substantially to the past growth in fertiliser use.

Notwithstanding the valid rationale behind the above strategy, it had one very crucial limitation. Its primary focus was

n enlarging supplies, c ntrolling the dis ribution of available supplies, and creating distribution outlets to facilitate utilization of available fertilisers.[45] Genuine difficulties experienced in these spheres further strengthened the faith of the policy makers in the correctness of the strategy. While such an interpretation of the task of increasing fertiliser use led to many policy measures to improve the supply and distribution systems over years, it also created an environment in which there was very little, if any, correct appreciation of the forces which were governing growth in cultivators' effective demand for fertilisers.[46]

The lack of concern for the demand for fertiliser did not po e any problem so long as the actual level of fertiliser use was substantially below the potential, particularly in irrigated areas an In such rainfed situations where fertiliser responsive commercial crops dominated. This was because the size and certainty of returns fr fertiliser use in such situations generated adequate growth in cultivators' demand to absorb the growing supplies even without concerted efforts to create growing demand for this input. Empirical evidence clearly shows that till mid-1960s, the growth in fertiliser

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[45] This is reflected in the approach behind setting targets of fertiliser use in Five Year Plans, and explanations given for the shortfalls in achieving the planned targets. It is also reflected in various policy documents and policy measures related to fertiliser use.

[46] Even the shift from need-based target setting approach, followed upto the Draft Fifth Plan, to demand-based approach in the final version of the Fifth Plan (1976) does not reflect the appreciation of the forces which govern growth in cultivators' demand for fertiliser. This is clearly brought out by unprecedented growth in the past trends required to attain the levels laid down in the final version of the Fifth Plan. There is no indication in the Plan as to how this will be achieved as far as the demand aspect is concerned.

se was primarily gover d by increasing n mber of cultivators adopting fertiliser use on a few crops in the above regions. Improvement in the price environment for cultivators, resulting from the overall economic conditions in the country, accelerated the adoption-diffusion process. It must, however, be noted that it remained confined mainly to the above areas, and there too on a limited number of crops.

As the above adoption-diffusion process started approaching its upper limit in the late 1960s, the growth in effective demand for fertiliser resulting from this process started slowing down. But it did not manifest itself in the trends of fertiliser consumption. This was because, in the meanwhile, high yielding varieties were introduced, and they were spreading rapidly in some of these areas, particularly where wheat was grown under good irrigated conditions. Fertiliser use on these varieties, at substantially higher rates than on local varieties, was very profitable to cultivators. Consequently, the slowing down in the growth of effective demand due to the limited adoption-diffusion process reaching upper limit was more than offset, and there was an acceleration in the trends of fertiliser consumption.

Though the problem of slackening off in the growth of effective demand did not manifest as deceleration in the trends of fertiliser consumption, it did manifest as huge carryover stocks for four consecutive years from 1967-68 to 1970-71. Though the prevailing trend in fertiliser consumption was totally insufficient to achieve the Fourth Plan targets of fertiliser use, the phenomenon of huge carryover stocks was not understood and stressed as one due

to inadequate growth in effective demand.[47] Instead, it was recognised as one of excess supply due to various imperfections in the distribution system. The policy makers coped with the situation by substantially reducing imports, which accounted for over 50 per cent of domestic availability, and liberalising the distribution system which was till then governed by the pool arrangements and distribution through the cooperative institutions.

The continuous reductions in imports during the late 1960s and changed conditions in the world fertiliser market created tighter availability of fertiliser in the early 1970s. This reinforced the concern with supply and distribution rather than the demand aspect. It was only in 1974-75, a year of substantial decline in fertiliser consumption, when a widespread concern about demand for fertiliser emerged. Unfortunately, this decline in consumption came in the wake of sudden and substantial increase in fertiliser prices due to the Oil Crisis. Consequently, of all factors governing demand for fertiliser, its price was the only one which was singled out as the problem issue.

The adverse impact of the substantial rise in fertiliser prices on the level of fertiliser use in 1974-75 cannot be denied. Similarly, it would be incorrect not to recognise the change in the price environment in the post-Oil Crisis period. It should not,

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[47] A pointed attention was drawn to the emerging problem on the demand side in late 1960s. See Gunvant M. Desai and Jon W. Mellor, "Changing Basis of Demand for Fertiliser," Economic and Political Weekly, Vol. IV, No. 39, Review of Agriculture, September 27, 1969, pp. A175-A187.

however, be overemphasized. This would be particularly true if the objective is to understand which policy measures are needed to generate continuous rapid growth in fertiliser use. There are three main reasons, revealed by the analysis in Sections II and V, behind this contention. First, not all was well with the forces governing the trends in demand for fertiliser even before the rise in fertiliser prices in 1974-75. Second, even after the increase in fertiliser prices, the relative price situation is at least as favourable to cultivators as in the early 1960s because of the rise in the prices of agricultural commodities. Finally, price of fertiliser is only one of the factors which affect growth in cultivators' effective demand for fertiliser. It is, thus, clear that marginal manipulation of the price environment cannot generate sustained rapid growth in demand for fertiliser.

Various conclusions emerging from the analysis in this chapter, thus, clearly suggest that vigorous policy measures are required in several directions if fertiliser use is to grow continuously and rapidly. Undoubtedly, these measures should aim at further improving the supply of and distribution systems for fertiliser. It would be, however, erroneous to conclude that improvements in supply and distribution systems by themselves will generate continuous rapid growth in fertiliser use. As shown by the analysis in Sections III and IV, under our conditions, they only facilitate the growth in fertiliser use which results from the growth in cultivators effective demand for this input.

Thus, what is crucial are the policy measures to generate accelerated growth in cultivators' demand for fertilisers. To do this, the strategy behind the policy measures must be to broaden continuously the base which supports the growth in effective demand for fertilisers. Major things which are required to do this are: (i) developing irrigation facilities at an accelerated pace, (ii) strengthening research to evolve fertiliser responsive varieties of all major crops, varieties which are suitable to both irrigated and unirrigated areas, (iii) rapidly promoting fertiliser use under rainfed conditions by convincing cultivators' about the size and certainty of returns from fertiliser use under such conditions, and (iv) training cultivators in such details of optimal fertiliser practices as correct number, timing and method of fertiliser application, balanced use of different nutrients, and use of micro-nutrients and/or soil amendments.[48]

Recent developments indicate that the domestic fertiliser industry is getting involved in fertiliser promotion work. While this is a welcome departure from the past, one cannot expect it, by itself, to generate anything like the required quantum of 600,000 tonnes a year growth in demand for fertiliser. To attain this, there is no alternative to the measures listed above. Unless these measures are vigorously undertaken, it seems virtually certain that the prevailing level of fertiliser use will not rise to the levels laid down in the Fifth Plan for 1978-79 and 1983-84, the levels

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[48] For details, see Gunvant M. Desai and Gurdev Singh, Op.cit., pp. 187-212.

which are consistent with all evidence on what is required to generate the planned growth in agricultural production.[49]

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[49] For the evidence, see John W. Mellor, The New Economics of Growth, A Strategy for India and the Developing World, Cornell University Press, Ithaca and London, 1976, Chapter III, pp. 48-75; also see Gunvant M. Desai, Nitrogen Use and Foodgrain Production, India, 1973-74, 1978-79, and 1983-84, Department of Agricultural Economics, Cornell University, Ithaca, 1973.

Appendix

Farm Harvest Prices, Nitrogen Price and Ratios of Nitrogen to Farm Harvest Prices in Some Years between 1958-59 and 1972-73

	1958-59	1963-64	1968-69	1972-73	1958-59	1963-64	1968-69	1972-73
	Rs. per Quintal				Ratio of N to Crop Price			
Rice	48.50	60.00	97.55	115.48	3.86	2.87	2.12	1.78
Wheat	42.00	50.00	82.78	116.72	4.45	3.44	2.50	1.76
Jowar	34.00	40.00	63.63	95.93	5.50	4.30	3.25	2.14
Bajara	38.00	44.00	72.12	96.95	4.92	3.91	2.87	2.11
Cotton (Kapas)	93.33	120.00	155.22	261.40	2.00	1.43	1.33	0.78
Sugarcane	3.94	5.94	11.01	13.56	47.46	28.96	18.80	15.12
Nitrogen	187	172	207	205				

Note : The average price for each crop is arrived at by weighing the prices in different states by areas under the crop. Similarly, the average nitrogen price is arrived at by weighing the prices of different nitrogenous fertilisers by their relative importance in total nitrogen consumption

Sources : Different volumes of Agricultural Situation in India, and Fertiliser Statistics, 1974-75