7.1 SUMMARY

Findings on spread and rates of fertiliser use based on 52 groups of cultivators scattered over the country reveal that there is a hierarchy of crops in terms of fertiliser use. During the pre-HYVs period, sugarcane, paddy, and wheat grown under irrigated conditions were fertilised extensively. In the post-HYVs period also besides the fertiliser responsive commercial crops like sugarcane, it is the HYVs of foodgrains which have been extensively fertilised and at high rates. The traditional varieties of minor cereals (namely, jowar, bajra, and millets), pulses, and oilseeds particularly when grown under rainfed conditions, have remained outside the mainstream of fertiliser use.

This hierarchy among different crops has been consistently maintained over time and in different places in the country. This indicates that growth in fertiliser use during the post-HYVs period was faster on crops where fertiliser use was comparatively high in the earlier period. The only difference in pre and post-HYVs pattern is the source of growth in fertiliser use. While the spread of fertiliser use was responsible
for pre-HYVs growth in fertiliser use, it is improvement in the rates of fertiliser application which is responsible for post-HYVs growth.

The above pattern is governed by size and certainty of returns on fertiliser use. Crops and farming situations where fertiliser use have been extensive on all size of farms are cases where the returns on fertiliser use have been high and more certain. On the other hand, crops and farming situations where potential for fertiliser use exists but the actual use is low and concentrated on large size of farms are situations where the variations in returns are so high that widespread diffusion of fertilisers had not taken place by the mid 1970s. In fact, the incentives to diffuse fertiliser (net returns) as well as to increase its rates of application (marginal returns) are unattractive in the case of non-responsive farming situations. Improvement of prices in favour of cultivators has not improved these returns significantly enough for fertiliser use to gather momentum in such situations.

In essence, the observed pattern of fertiliser use at micro level is governed by the profitability of its use in absolute terms. Among the two variables affecting profitability, physical productivity of fertiliser use is more important than prices of crops and fertilisers.
These micro findings are further extended to explain the fertiliser use at macro level. In doing so, the movements of fertiliser use towards its changing potential are explained with the help of cultivators' expectations about the physical productivity and real price of fertilisers. Marginal physical products lagged by a year, estimated from production function analysis, are used to represent cultivators' expectations about the physical productivity of fertilisers.

Findings of fertiliser use at macro level reveal that about 68 per cent of inter-state variations in fertiliser use relative to its potential are explained by cultivators' expectations about the physical productivity of fertilisers. Findings of cross-sectional demand analysis also reveal that real price of fertilisers is not an important variable in explaining the fertiliser use. Time series fertiliser demand analysis reveals that cultivators' expectations about the physical productivity and real price of fertilisers explained about 92 per cent of variations in nitrogen use towards its changing potential. Expectations about the productivity of fertiliser alone has contributed about 78 per cent to the explained variations. Apart from the above, a proportionate rate of growth in fertiliser use is maintained by changes in potential for its use. Increase in irrigated area along with
associated cropping pattern changes accounts for over three-fourths of the variations in the potential (Appendix 7.1).

Since, irrigation not only affect the potential but also affects the parameters of production function, for rapidly increasing fertiliser use the importance of rapidly increasing irrigation is thus clear.

7.2 CONCLUSIONS AND POLICY IMPLICATIONS

The base which has generated the past growth in fertiliser use has been narrow. This growth has occurred mainly due to improvement in the rates of fertiliser application on irrigated conditions more particularly HYVs of foodgrains and commercial crops like sugarcane.

Growth in fertiliser use from this source was maintained because of rightward shift in fertiliser demand functions resulting from shifts in production function. This growth has exhausted its vigour under the existing response environment.

Also, any shift in cropping pattern in favour of these high fertiliser consuming crops cannot be expected without quantitative improvement in irrigation coupled with avenues of assured markets for output.1 On the other hand, available irrigation has started

constraining further diffusion of HYVs. For any further improvement in spread and rates in these cases, either the irrigated area should increase rapidly or the existing HYVs should be replaced by more responsive new varieties.

In a spatial dimension where rainfed areas have remained outside the mainstream of growth in fertiliser use, the fertiliser distribution and research-extension systems developed to cater the needs of irrigated high growth areas only. This development even in these areas has been merely to facilitate the demand. But in the process, neither the distribution network considered to expand into the rainfed area economically viable, nor the agronomic complexities of these regions received adequate importance in the priorities of research and extension system.

If the irrigated area and diffusion of HYVs continues to change as anticipated in the Sixth Plan, the potential for nitrogen use in 1984-85 would be about 8 million tonnes. However, a significant portion of the untapped potential consists of crops and location where fertiliser use is not common. Also growth in fertiliser use from the traditional sources would not be enough to meet the need-based growth of about 0.5 million tonnes of nitrogen per annum. It is this fact which signifies the importance of phased diffusion of fertilisers on rainfed
traditional varieties of minor foodgrains and oilseeds on the one hand, and diffusion of new fertiliser responsive varieties on these newly fertilised area on the other.

Persisting oil crisis has made fertilisers a costly input. In spite of this, fertiliser use has grown substantially not only during comparatively favourable price environment but even in post-oil crisis period too. These micro findings are further supported by the fact that only an insignificant portion of year to year variations in fertiliser use towards its potential are explained by the real price of fertilisers. These evidences suggest that the situations where both spread and rates of fertiliser use are extremely poor cannot be turned to growth generating centres through marginal manipulation of prices in favour of cultivators. Also, the social gain of subsidising fertiliser use under such low response environment would be very low.

In these situations, though the potential for fertiliser use exists, the actual use is low mainly because the variations in returns across the fields are so high that widespread of fertiliser has not taken place as such. The most important task for initiating rapid diffusion of fertiliser use under rainfed conditions is to stabilise the varying yield response of fertilisers.
This would call for extensive adaptive research to identify sources of response gaps between research stations and cultivators' fields on crops where fertiliser use is not common. This should be followed by a meaningful promotional effort. This task in India since long has been solely undertaken by the state.

Fertiliser industry can play an important role in this respect. After the changeover from cooperative to a marketing network where 60 per cent of the sale points are private, the fertiliser marketing has become commercial. But this commercialisation has facilitated concentration of use in traditionally high fertiliser consuming areas. Since these areas cannot sustain a rapid growth in fertiliser use year after year, pressures on industry to sell fertiliser in non-traditional areas have to be exerted. An instrument for creating pressure on industry could be through 'supply push' which influences the industry's efforts to create end users demand and expand the distribution network in non-traditional fertiliser consuming areas.2/

What are the policy interventions needed in order to convert the potential of about 8 million tonnes of nitrogen by 1984-85 into cultivators’ effective demand to meet need-based targets of 6 million tonnes of nitrogen use?

The decision to use fertilisers basically rests on individual farm firms depending upon their expectations about the profitability of their use. But this does not rule out the possibility of state interventions for regulating both demand for and supply of fertilisers. The growth in fertiliser use is influenced by availability of fertilisers, efficiency and expansion of distribution system, and improvement in cultivators’ demand. The findings of the present study, however, lead to policy interventions related to the demand for fertilisers. It is assumed that supply would grow at a faster rate than the demand for fertilisers.

Basic investment in agriculture is amongst the highly desirable interventions by the state for increasing and sustaining the growth of fertiliser use. Adequate investment in irrigation, drainage, flood control, land development, and fundamental agricultural research helps in two ways. It insulates productivity from the vagaries of monsoon and hence in the long run the yield increasing inputs may govern it. And, it opens avenues for an extensive technological change in agriculture, resulting in rightward shift in fertiliser demand function.
A vast unirrigated area in the country may neither receive benefits of such investment in the near future, nor can one rely upon the price policy as a force for generating growth in fertiliser use in these situations. In such cases, however, improving farming technique around agroclimatically adapted varieties would help in improving and stabilising the yield response.

The task involves (1) identifying varieties suited to different farming conditions, (2) improving the quality of irrigation or rainwater harnessing technique, (3) identifying appropriate time, method, quantity and type of fertiliser use, and (4) effective dissemination of generated information.

To sum up, for meeting need-based targets of fertiliser use, the following policy interventions are required:

(a) Improving fertiliser use efficiency in the case of rainfed jowar, bajra, pulses, and oilseeds; (b) Development of new fertiliser responsive varieties for both rainfed and irrigated agriculture; (c) Strengthening the extension and supply arrangements in areas where fertiliser use is not quite common; and (d) rapid increase in irrigated area and diffusion of HYVs in the newly irrigated areas.
APPENDIX 7.1

SOURCES OF GROWTH IN POTENTIAL FOR NITROGEN

Analysis of factors affecting the potential becomes relevant because of the fact that changes in potential affect fertiliser use in two ways. First of all, it increases the limits of growth in fertiliser use. Secondly, since some of the variables affecting potential also affect the parameters of the production functions such an analysis is important for increasing growth in fertiliser use.

The changes in potential for nitrogen use, the way it is estimated, are due to variations in irrigated area, cropping pattern changes, and diffusion of HYVs. Since there is high correlation between irrigation and cropping pattern, irrigation alone is taken as a variable, which combines the effect of both (Equation 7.1.3). The following specification is used in the analysis:

\[
\log G_{it} = \log a + b_1 \log I_{it} + b_2 \log HYV_{it} + b_3 \log CP_{it} + e_{it}
\]

where

\[i = 1 \text{ to } 12 \text{ states}\]
\[t = \text{ years between 1961-62 and 1975-76}\]
\[G_{it} = \text{ potential for nitrogen use in } i^{\text{th}} \text{ state in } t^{\text{th}} \text{ year in kg./hectare}\.]
$I_{it} = \text{percentage of cropped area irrigated in } i^{th}\text{ state in } t^{th}\text{ year.}$

$HYV_{it} = \text{percentage of paddy and wheat area under HYVs in } i^{th}\text{ state in } t^{th}\text{ year.}$

$CP_{it} = \text{cropping pattern score in Rs. per hectare in } i^{th}\text{ state in } t^{th}\text{ year.}$

The statistical results of Equation 7.1 are given in the following equations:

7.1.1 $\log G = \log 1.3220*** + .4029*** \log I$

$R^2 = .67$

$DW = 2.3$

7.1.2 $\log G = \log 1.3749*** + .4093*** \log I + .0711 \log HYV + .1013 \log CP$

$R^2 = .76$

$DW = 2.7$

7.1.3 $\log G = \log 1.9492*** + .4093*** \log I + .0691*** \log HYV$

$R^2 = .76$

$DW = 2.4$

About 76 per cent of the variations in the potential for nitrogen use are explained by irrigation, and HYVs (Equation 7.1.3). Irrigation along with associated cropping pattern changes account for over three-fourths of the explained variations. Both the explanatory variables have expected sign and are significant at 1 per cent level.