CHAPTER - TWO

OBJECTIVES AND METHODOLOGY

The Problem:

The preceding chapter has tried to explain that fertilizers will have to play, as in the past, a crucial role in stepping up agricultural production in the years to come. However, due to a number of constraints prevalent in Indian agriculture, the task ahead of increasing fertilizer use is a challenging one. Therefore, the first chapter has brought in light the two important enquiries relating to the future fertilizer development policy which form the major objectives of this study. In this context, this chapter tries to present the objectives of the wider study of this thesis, along with the research methodology that is followed for the study.

Objectives:

(I) The first major objective of the study is to find out the ways and means through which a rapid increase in fertilizer use in Indian agriculture can be attained. This needs a deep probe into the facts relating to the behaviour of the past fertilizer consumption pattern. The aspects to be inquired into can be laid down as under:

(a) What was the share of each state in the total all India consumption of Nitrogen (N), Phosphorous (P), and Potash (K) and how did it change over time?
(b) How did fertilizer use increase in the different states over a period of time and what was its nature of growth?

(c) What is the nature and extent of attainable future potentialities of fertilizer use with respect to kharif and rabi seasons in each state?

(d) What was the state of development in fertilizer use per hectare of gross cropped area (GCA) in the different states? and what was the change in it at different points of time?

(e) What was the growth rate of fertilizer use per hectare of GCA in the different states and how did it change over time?

(f) What is the nature and extent of attainable future potentialities of fertilizer development in each state?

(II) The second major objective of the study is: how to promote the scientific fertilizing practices most effectively? Again, this inquiry generates the other subinquiries as under:

(g) Which are the important means for promoting scientific fertilizer application practices and how far have they been put into practice?

(h) Which measures have been introduced by the prevailing extension agencies to promote scientific fertilizing practices?
(i) To what extent the measures towards scientific fertilizing practices remained successful? and
(j) How to encourage scientific fertilization in the future with removal of constraints therein?

(III) Finally, the third major objective is put up as:

(k) To lay down the important planning implications for the future fertilizer development policy to raise the overall optimum consumption of the various nutrients in the Indian agriculture.

**METHODOLOGY**

The discussion includes data base as well as the analytical framework of the study.

**Data Base:**

The analysis of the thesis is based on the various types of data available in the different published sources principally of the Fertilizer Association of India. The necessary micro level data have also been obtained from the various micro level studies completed with respect to fertilizer consumption pattern. Data on the consumption of Nitrogen (N), Phosphorous (P) and Potash (K) for both kharif and rabi seasons are available for a period of 1975-76 to 1985-86 from the source Fertilizer Association of India (FAI). FAI also makes use of the information available from Departments
of Agriculture of various State Governments while preparing its annual publication named "Fertilizer Statistics." Hence, the statewise informations on the consumption of N, P and K are obtained from FAI publication (FAI Annual 1975-76 to 1985-86). Information series on the consumption of N, P and K per hectare of gross cropped area (GCA) is compiled by using the available information on GCA from the various FAI publications (FAI Annual 1975-76 to 1985-86). Besides, for quantitative as well as qualitative informations needed for the study the following sources were approached:


** Authorities of the State Government at various levels dealing with extension services and agricultural development programmes viz., Directorate of Agriculture, District Development Office, District Agricultural Officers, Panchayat Offices, etc.

** Industrial Research Centres of Gujarat State Fertilizers Company Limited, Baroda and Gujarat Narmada Fertilizers Company Limited, Broach.

** Various departments involved in fertilizer research programmes at Anand Agricultural University.

**Primary Data:**

In order to collect the needful informations in connection with the major objectives of this study, a well
prepared questionnaire was also canvassed to the farmers which contained aspects such as farmers' awareness about the existing scientific fertilizing practices, their attitudes and opinions regarding modern fertilizing practices, etc.

While field survey it was also attempted to obtain farmers' views about possible favourable changes in the current fertilizer development strategy.

Analytical Framework:

The period selected for the detailed analysis refers to the period/decade from 1975-76 to 1985-86. The selection so made is based on the following considerations:

(1) From the point of view of the nature of growth in fertilizer use, the period under study (1975-76 to 1985-86) significantly differs from the earlier period prior to 1966-67. The earlier period was characterised by almost traditional type of agriculture with a very low level of fertilizer use along with the lower use of other inputs in terms of relatively lower area under irrigation, traditional varieties of seeds, etc.

(2) From 1966-67, with the introduction of HYVs and other developments the agricultural sector improved to a substantial extent in terms of yields of different crops consequent upon the increased use of the different strategic inputs. So the use of fertilizers increased at a rapid rate.
(3) Once the sudden jump in the use of strategic inputs was established on fairly a sound base, the scope of further increase in fertilizer use cannot be expected to be as rapid afterwards as was observed in the initial period of HYVs (Desai 1986, p. 928).

(4) Therefore, the earlier period cannot serve as a period to provide guidelines for the future. The only period which can be taken for such base has to be the near past which has been taken from 1975-76 for this study.

(5) The four years period from 1975-76 to 1978-79 and 1982-83 to 1985-86 is also taken up on the ground of the third point mentioned above. It is precisely implied over here that once the sound base for agriculture is established slowly it gets strengthened over a period of time followed by a saturation stage/stagnant situation unless new innovation like HYVs stimulates it. Thus, for the fertilizer growth in future the recent past rather than the long period since 1950-51 to 1985-86 is more important and would provide a more appropriate base for determining policy guidelines for future fertilizer use.

It is well recognised that the analysis based on the statistics relating to a single year does not provide a normal picture. So a four years' average (state-level) was obtained
and was used throughout in this research study. The different periods noted in the analysis are as under:

1. 1975-76 to 1978-79 = First period
2. 1979-80 to 1982-83 = Second period
3. 1982-83 to 1985-86² = Third period

The average figures for all these three periods were separately worked out for all the nutrients for both the seasons (kharif and rabi seasons) and for the year as a whole.

An attempt is now made to present all the tools and techniques which are used in the following chapter as per their respective order of presentation.

(1) **Historical Analysis:**

The discussion of this part of the analysis is largely based on the four following concepts:

(a) Average of annual and season-wise consumption of N/P/K/NPK nutrients (AC).

(b) Average annual and season-wise percentage share of N/P/K nutrients in the total (N+P+K) consumption of all nutrients (APS).

(c) Average annual and season-wise rate of change in absolute consumption of N/P/K/NPK nutrients (GR).

(d) Average annual and season-wise rate of change in consumption of N/P/K/NPK nutrients in percentage term (GRP).
(A) Average of annual and season-wise consumption of N/P/K/NPK nutrients (AC):

This refers to average consumption of a nutrient for a specific period in a specific season. Using the Arithmatic mean, AC is worked out for various nutrients for different periods under study. The formula to work it out is as under:

\[ \bar{\text{NXSj}} = \frac{\sum_{i=1}^{4} N_{XSji}}{4} \]

Here, \( \bar{\text{NXSj}} \) = Average consumption of N nutrient in X state during Sth season in jth period, in tonnes.

\( N_{XSji} \) = Absolute consumption of N nutrient in X state during Sth season in jth period for ith year in tonnes.

X = States i.e., 1, 2, 3, .......... 17.
S = K, R, A, i.e., Kharif, Rabi and Annual respectively.
j = Time period i.e., 1, 2, 3
i = 1, 2, 3, 4 years

Similar formula is used for nutrients P/K/NPK.

(B) Average annual and season-wise percentage share of different nutrients in the total (N+P+K) consumption of all nutrients (APS):

This refers to percentage share of a nutrient to the total consumption of fertilizers for specific season in a specific period. This is worked out as under:
\[ \frac{\text{PN} \times S_j}{\text{NN} \times S_j + \text{PF} \times S_j + \text{KK} \times S_j} \times 100 = \frac{\text{NN} \times S_j}{\text{TF} \times S_j} \times 100 \]

where,

- \( \text{PN} \times S_j \) = Average percentage share of \( N \) nutrient in the total consumption of all the nutrients in \( X \) state during \( S \)th season for \( j \)th period.
- \( \text{NN} \times S_j \) = Average absolute consumption of \( N \) nutrient in \( X \) state during \( S \)th season for \( j \)th period in tonnes.
- \( \text{TF} \times S_j \) = Average absolute consumption of total (\( N+P+K \)) nutrients in \( X \) state during \( S \)th season for \( j \)th period in tonnes.

All the other notations (\( x \), \( s \) and \( j \)) are just the same as given in the earlier formula for AC.

The APS for \( P \) and \( K \) is worked out by replacing \( N \) in the above given formula.

(C) **Average annual rate of Change (GR):**

In order to estimate the \( GR^3 \) in the consumption of \( N \), \( P \), \( K \) and NPK together, for the seasons kharif, rabi and annual for the three periods under study, total numbers of 36 linear equations of the following types for each of the 18 states including India as a whole were estimated.

\[ Y_{sij} = a_{sj} + b_{sj} T \]

where, \( Y_{sij} \) = \( N \) (or \( P \) or \( K \) or NPK) nutrient consumption in \( S \) seasons of \( i \)th year of \( j \)th period in tonnes.
asj = intercept of the equation estimated for S season in jth period.

bsj = average absolute rate of change in consumption of a nutrient under study for the 'S' season of the jth period in tonnes.

T = time variable, i.e., Q = 1, 2, 3, 4, j = 1, 2, 3.

S = K, R, A i.e., Kharif, Rabi and Annual respectively.

(D) Average annual and season-wise rate of change in consumption of N/P/K/NPK nutrients in percentage term: (GRP)

This is nothing but GR discussed above in percentage term. It is worked out as under:

\[ \frac{\overline{N} \times bsj}{\overline{N} \times sj} \times 100 \]

Where, \( \overline{PNxjsj} \) = Average annual rate of change in percentage (GRP) of 'N' nutrient in X state with respect to Sth season for jth period.

\( \overline{Nxbjsj} \) = Average absolute annual linear rate of change of N nutrient in X state during Sth season for jth period.

\( \overline{Nxsj} \) = Average absolute consumption of N nutrient in X state during Sth season for jth period.

All the other notations are just the same as given in the formula for AC.
GRP with respect to other nutrients is also obtained by substituting P, K and NPK in the place of N in the above given formula.

(2) Average Concentration of various Nutrients (ASC):

This refers to the proportionate use of a nutrient in X state in the total consumption of a nutrient in the country as a whole. Formula used for this purpose is:

\[
ACN_{xsj} = \frac{\sum_{i=1}^{4} \frac{N_{xsj}}{N_{Gsj}} x 100}{\sum_{i=1}^{4} N_{Gsj}}
\]

where,

\(ACN_{xsj}\) = Average percentage share of X state in consumption of N nutrient to its respective total consumption in the country as a whole during 5th season in the jth period.

\(N_{xsj}\) = Absolute consumption of N nutrient in X state during 5th season in the jth period for the ith year.

\(N_{Gsj}\) = Absolute total consumption of N nutrient in the country as a whole during 5th season in the jth period for the ith year.

All the other notations are just the same as given in the earlier formula for AC.
Using the same formula, average concentrations for P/K/NPK were worked out by replacing N in the above formula.

Here, summation of all States' respective shares i.e., $ACNxsj$ would equal $100^4$ per cent that is the total consumption of N nutrient in the country as a whole. The results obtained by the use of this formula can be understood with the help of the following example:

If Uttar Pradesh obtained 22 per cent share, this means that of the 100 per cent use of N in India during 5th season in $j$th period, 22 per cent of it (N) is used only by Uttar Pradesh. So in the remaining states the use is of 78 per cent. Thus, $ACNxsj$ indicates the average share of a nutrient in the X state in the total consumption of that nutrient in the country as a whole in 5th season for $j$th period, that brings in a comparable picture across states. On the basis of the percentage share obtained by each state, all the states have been classified into the following four sub-groups:

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Percentage of Nutrient Use</th>
<th>Name of the Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>8.00 and above</td>
<td>High</td>
</tr>
<tr>
<td>2.</td>
<td>4.00 to 8.00</td>
<td>Medium</td>
</tr>
<tr>
<td>3.</td>
<td>1.00 to 4.00</td>
<td>Low</td>
</tr>
<tr>
<td>4.</td>
<td>1.00 and below</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

Of course, this classification is arbitrary. The classification so obtained was arrived at by taking 100 per cent
fertilizer consumption in the country and dividing it by 25 states. This worked out to 4.00 per cent. So states above 4.00 per cent were considered as medium and high fertilizer consuming states while below it as low and very low fertilizer consuming states.

(3) Development Analysis: Fertilizer Use Per Unit of Area:

In concentration analysis noted above it is quite possible that a particular state may obtain high concentration in a specific nutrient if its cultivated area is relatively large while this very state may use less of the given nutrient per unit of area for want of credit, irrigation facility, the absence of an active role of the local state government in promoting fertilizer use etc. Therefore, concentration analysis ignores the state of affairs regarding the factors which play a deterministic role in the fertilizer development.

Fertilizer use per unit of area is a real indicator with respect to position of various fertilizer development factors in a state. For example, high fertilizer use per unit of area in any state means development factors are stronger in that state as these factors encourage more fertilizer use and on the contrary if some other state uses small quantity of the same nutrient then it can be said that all or some of the development factors are weaker in the state other things remaining the same. Therefore, it can be maintained that
larger fertilizer use per unit of area in any state means all or some of the fertilizer development factors are stronger in that state while smaller fertilizer use means some or all of the development factors are weaker in a concerned state.

In this study, development analysis refers to average annual consumption of N/P/K nutrients per hectare of gross cultivated area (GCA) in each state. This was worked out using the following formula:

\[
D \bar{N}xj = \frac{\sum_{i=1}^{4} Nxji}{4}
\]

where,

\( D \bar{N}xj \) = Average state of development/average annual consumption of N nutrient per hectare of GCA in X state during jth period in kgs.

\( Nxji \) = Absolute annual consumption of N nutrient per hectare of GCA in X state during jth period for ith year in kgs.

4 = A number of years in each period under study.

All the other notations are just the same as given in the formula for AC in the earlier part. Similar formula is used for working out Average State of development with respect to P, K nutrients for various periods under study by replacing N in the above given formula.
Organization of A Micro Level Study:

In Chapter 4 it has been clearly brought out that obtaining scientific fertilizer use in an agricultural sector largely depends on three factors viz.,

(1) availability of adequate and efficient means to promote scientific fertilizer use (soil testing laboratories);

(2) working of extension agencies (in the case of Indian agriculture three agencies perform this function viz., (Government, Corporate and Co-operative sectors), and

(3) Farmers' acceptability of new knowledge about scientific fertilizer use. The first as well as the second factor have been analysed in detail in the fourth chapter of this study. To gather an idea about the third factor it is pertinent to conduct a micro level study.

Significance of A Micro Level Study:

To put forth a new strategy to promote scientific fertilizer use all the relevant aspects at the grass-route level need be examined. They are; (i) the extent of success of the prevailing extension agencies in promoting scientific fertilizer use at the farm level, (ii) The nature of farmers' awareness about scientific fertilizer use. (iii) The attitudes and opinions of farmers towards scientific fertilizer use; etc. All these aspects put together determine the scientific fertilizer use at the farm level. Therefore, a critical study
of all these aspects would help frame an appropriate scientific fertilizer development policy for the future.

All the above given three aspects have been incorporated in a designed questionnaire which was canvassed to sample cultivators in three different villages as selected on the following grounds.

**Selection of the Locale:** In the above context to examine the impact of the three different types of extension agency three villages have been purposively selected. However, the selection of each village was made in such a way that one of the three types of agency principally work in one of the three villages as follows:

**Government Sector:** In Gujarat, Government sector renders extension service through a system known as Training And Visit System (T and V system). In this system, a village level worker - a lowest level personnel in the cadre of extension staff meets farmers and provides required informations to them as per training given to him from his headquarter which is usually situated at a taluka level with appropriate linkages with district headquarter. As extension system of the government is similar throughout Gujarat, (Govt. of Gujarat, 1984, p. 9) among various districts in Gujarat, Kheda district is selected for it is a local district for our purpose. Then, Anand taluka was selected for it is near from researcher's working place. Afterwards, officer in charge of
Anand headquarters, T. & V. system was contacted and asked to indicate the village wherein the best impact of extension programme prevails. Here, Bakrol village was suggested to have the best extension impact. So Bakrol village was selected as a representative of the Government sector.

Corporate Sector: Beside the Government, Corporate Sector provides extension services to farmers in Gujarat. Corporate Sector constitutes of a number of fertilizer producing companies. All these companies provide extension services by framing their respective sales promotion strategy together with extension strategy. The whole market area determined by each fertilizer company is usually the area under extension strategy of a concerned company. A sales representative in charge of a fertilizer depot of any company also performs functions of an extension man of the concerned company and renders extension services to farmers. Thus, the whole corporate sector provides extension services to farmers. As the method of providing extension service to farmers is the same in the case of all the corporate companies, among the different fertilizer producing companies in the above selected locale (i.e., Kheda district) Gujarat State Fertilizer Company Limited (G.S.F.C.) was purposively selected. A sales promotional assistant of this company in a fertilizer depot at Karamsad village was contacted. He was asked to indicate a village where extension impact of G.S.F.C. is fairly good. He suggested Gana village, so Gana village was selected as the representative of the Corporate Sector.
<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Sector</th>
<th>Village</th>
<th>No. of selected farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Government</td>
<td>Bakrol</td>
<td>34</td>
</tr>
<tr>
<td>2.</td>
<td>Government and Corporate</td>
<td>Gana</td>
<td>33</td>
</tr>
<tr>
<td>3.</td>
<td>Government and Co-operative</td>
<td>Ravipura</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The total sample farmers</td>
</tr>
</tbody>
</table>

Thus, the study covers 100 sample farmers. Afterwards, a designed questionnaire was canvassed to the sample farmers.
Notes:

1. To fit in the analysis, twelve year period has been divided into three equal parts. Thus, four year averages were obtained.

2. During this period there was a little change in the fertiliser reporting year from Feb-Jan. to April-March followed by a change in Kharif and rabi seasons. This change is well considered while analysing the obtained informations.

3. GR refers to absolute consumption of fertiliser in tonnes. The same method is used in working out rate of change of various nutrients per hectare of Gross cropped Area for given time variables.

4. In the present study, summation does not equal to 100 per cent for want of consistent data availability about consumption of various nutrients in the case of Union Territories and the remaining states.

5. These data are directly taken from FAI Annual publications, 'Fertiliser Statistics' from 1975-76 to 1985-86.

6. These farmers were covered under T. & V. System on the ground that they were co-operative to a village level worker. Hence farm size wise representation cannot be expected here.

7. As the Govt. extension system prevails throughout the district, and so it was also working in the area of corporate sector i.e., Gana village and co-operative sector i.e. Ravipura village of this study.