CHAPTER - III
RESEARCH METHODS

Selection of Villages

In view of the objectives of this study, the main problem was to identify the Modernised and Traditional Villages in the Block. The simplest method would have been to take the guidance of the Block officials. But this method would have been a biased one and therefore, it was decided to rank the villages with respect to the adoption of new technology.

The impact of new technology at the village and the farm level will be in one or more of the following ways: (1) adoption of High Yielding Varieties, (2) cultivation of new crops - hitherto not cultivated in the area, (3) higher use of fertilisers per acre, (4) creation of needed resources (infrastructure) for the adoption of the above two - mainly the creation of assured irrigation facilities, (5) increasing use of improved farm machinery and (6) increasing use of plant protection methods. All these if used judiciously would necessarily result in higher production and transformation of traditional agriculture into modern one.

In order to rank the village in the order of adoption of modern technology, basic information was collected for all the 124 villages of old Dobhi Block. The data thus collected revealed that reliable information was available only for 105 villages and that too only on three items viz.

* area under assured and effective irrigation, area under High Yielding

* For working out the area under assured irrigation, it was estimated that one State Tube Well could irrigate 100 acres effectively and one small private tube well could handle 15 acres at the present level of intensity of cultivation and existing cropping pattern.
Varieties and use of fertilisers. Thus the villages were ranked on the basis of percentage area under assured irrigation, percentage area under High Yielding Varieties and per acre use of fertilisers.

All the 105 villages were ranked according to the magnitude of modernisation based on factors like percentage area under assured and effective irrigation ($x_1$), percentage area under High Yielding Varieties ($x_2$) and per acre use of fertilisers ($x_3$).

Now the hypothesis has to be tested that there is no agreement between these factors and the rankings are arbitrary arising by chance alone. The expected rank total for each village, based on Null hypothesis will be given by:

$$m \frac{(n+1)}{2}$$

where,

- $n$ is the number of villages
- $m$ is the number of factors, considered to be contributing towards the modernisation of the villages.

To test the hypothesis Snedecor's F distribution has been used to determine whether the Null hypothesis of randomness originally set up is true or not. For this purpose F statistics was calculated as under:

$$F = \frac{(m - 1) C^1}{1 - C^1}$$

where,

$$C^1 = \frac{\sum_{i=1}^{n} D_i^2 - 1}{m^2 (n^3 - n) + 2}$$

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Where,

\[ C^* \] is corrected coefficient of concordance
\[ D_i \] is the difference between the observed and expected total rank for \( i \)th village.
\( m \) is the number of factors considered, and
\( n \) is the number of villages.

The expected rank total for each village based on the Null hypothesis formed will be equal to \( \frac{m(n + 1)}{2} \)

Now test \( F \) at \( \lambda_1 \) and \( \lambda_2 \) d.f.

where,
\[ \lambda_1 = (n - 1) - \frac{2}{m} \]
\[ \lambda_2 = (m - 1) \lambda_1 \]

In the present study \( F \) works out to be 9.80 with \( \lambda_1 = 103.3 \) and \( \lambda_2 = 206.7 \). The observed \( F \) is highly significant at 1 per cent level of significance. Therefore, the hypothesis is rejected and the villages are ranked on the basis of the observed total ranks.

Thus, after ranking the villages, four villages from the top 15 per cent and two villages from the bottom 15 per cent were selected randomly. The top villages are referred to as modernised villages while the bottom two as traditional villages for the purposes of this study.

List of the selected villages is given below in alphabetical order:

<table>
<thead>
<tr>
<th>Modernised</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bhulandih</td>
<td>1. Bardih</td>
</tr>
<tr>
<td>2. Chakra</td>
<td>2. Kanaura</td>
</tr>
</tbody>
</table>

* Desrciminant Function analysis was also applied to rank the villages on the basis of the magnitude of the factors contributing to modernisation of the villages. The results were almost identical with that of the pooled ranks, with only minor alterations. But the selected villages were from amongst the top and bottom 15 per cent for modernised and traditional respectively. The selection of the villages more or less conformed to the judgement of the Block Officials and knowledgeable persons of the Block.
The main purpose of the study was to study modernisation and its impact on farm organisation. Therefore, only two villages were selected from the Traditional group, in order to provide a comparative picture. Both sets of villages viz. modernised and traditional, do not differ materially so far as land ownership patterns, soils, and location are concerned. In fact one of the traditional villages is very well located - it lies on the Varanasi - Azamgarh road passing through this village - whereas none of the selected modernised villages is on the road.

Selection of Farmers

Once the villages were selected, a complete enumeration of all the families owning land was done in all the six villages recording their cultivated holding and related information. This enumeration revealed that there were many who had only 5 to 10 cents of land recorded in their names. Actually all these families were those of landless labourers or service classes and village artisans such as Lohars (Carpenter-cum-Blacksmith) Kohars (earthen pot makers) Banias (retail traders) etc. In fact they had never been a cultivating class. The land they owned was the land adjacent to the house sites once given as Mafi (gift land) by the landlords. Their main source of livelihood was other than farming. In the case of families working as farm labour, the cultivated land was mostly the land they received from their employers as part payment for their wages. In most cases these families did not maintain farm equipment and cultivated the land with the equipment of their employers free of charge.
Thus, it was obvious that it would be unwise to include such farms in a study of this nature which aims at measuring the impact of modernisation. All families cultivating less than 1.00 acre of land were excluded from the list of the farmers for drawing a sample for the purposes of this study.

The next problem was to define the size group of holdings. One alternative was to take the U. P. Government classification of economic holding, where 3.125 acres is the limit put for sub-division (taking as the minimum operating unit) and 6.250 acres as economically viable unit. Consequently holdings up to 3.125 acres would have been termed as small, 3.125 acres to 6.250 acres as medium and over 6.250 acres as large holdings. But in this area holdings are much smaller as compared to the State average. Also such a classification would not have provided a basis for comparison with studies in other areas.

Thus the size groups for this study were defined as follows:

- **Small farms**: Over 1.00 acre to 2.50 acres.
- **Medium farms**: Over 2.50 acres to 7.50 acres.
- **Large farms**: Over 7.50 acres.

Throughout the study small, medium and large farmers will refer to the classification as given above. After defining the size of holdings, farms falling in these categories were separated and all the small, medium and large farms from each of the modernised

* The farms from which the sample has been drawn cultivate 91.66 and 92.62 per cent of the land in modernised and traditional villages respectively.
villages were lumped together into different size groups. The same procedure was adopted for traditional villages as well.

After pooling, 30 farms were selected from each size group from the modernised villages and 15 farms from each size group from the traditional villages. The reason for the selection of equal number of farms was to have a comparative picture of modernisation for each size group, rather than to make any area estimates. A smaller number of farms were selected from traditional villages to have only comparative data to see the changes that have taken place due to the process of modernisation in modernised villages.* The number of farms selected from each size group from modernised and traditional villages are given in Table - 19, which shows that selected farms account for 35.2 per cent and 32.4 per cent of total numbers of farms in modernised and traditional villages respectively.

* These results may be utilized for area estimates as well, because a very high percentage of cultivated area (47.95 per cent in the case of modernized villages and 40.25 per cent in the case of traditional villages) has been covered by the selected farms.
TABLE - 19
Selected Farms as Percentage of Total Farms

<table>
<thead>
<tr>
<th>Items</th>
<th>Size group</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td>All</td>
</tr>
<tr>
<td>Total No. of modernised farms</td>
<td>120</td>
<td>85</td>
<td>52</td>
<td>257</td>
</tr>
<tr>
<td>Total No. of selected farms</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>90</td>
</tr>
<tr>
<td>Percentage of selected farms</td>
<td>25.0</td>
<td>35.3</td>
<td>57.7</td>
<td>35.2</td>
</tr>
<tr>
<td>Total No. of traditional farms</td>
<td>58</td>
<td>56</td>
<td>25</td>
<td>139</td>
</tr>
<tr>
<td>Total No. of selected farms</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Percentage of selected farms</td>
<td>25.9</td>
<td>26.8</td>
<td>60.0</td>
<td>32.4</td>
</tr>
</tbody>
</table>

Data Collection:

The relevant data used in this study have been collected both from primary and secondary sources. Secondary data were collected for the Block, the district and State from the Block Office and the State Department of Agriculture. Weather data were collected from the Meteorological Office.

Primary data were collected by survey method through personal interview of the farmers. For this purpose a structured schedule was prepared and pre-tested before starting the interviews. The data thus collected are reliable subject to the memory of the farmers as most farmers do not maintain any records. As the interviews were done fairly soon after the end of the agricultural year and farmers remembered almost all the information. In addition, most of the farmers were well-known to the author as he had worked in this area continuously for five years (1952-57).

Period of Study:

The data collected for this study relate to the agricultural year 1969-70.
ANALYTICAL METHODS

This section deals mainly with the methodology adopted for the analysis of data presented in the Chapters that follow. The emphasis here is on the multi-variate analysis of the production function as well as the factors determining different levels of Modernisation. It also deals briefly with the procedure adopted for preparing a composite index of Modernisation.

It has been felt that simple tabular analysis based on means, frequencies etc. suffers from some major limitations, as it cannot precisely measure the contribution of specific factors in combination with other factors which are responsible for changes in the level of output as a consequence of adoption of new technology. As the production function approach does not have this limitation, it has been used in this study. Production function analysis gives the marginal value productivity of resources at geometric mean level, which is more meaningful in the context of economic development, where the aim is to get maximum output from available resources. It also helps in judging the efficiency of resource use under different farm situations.

The empirical evidence from previous studies suggests that the Cobb-Douglas function is the most appropriate one for studies of this nature as it permits either diminishing, increasing or constant returns without using as many degrees of freedom as other functional forms having the same characteristics would. The coefficients of functions \( (b_1) \) give elasticities of production/remain constant throughout the
relevant ranges of inputs. The sum of coefficients \((b_1)\) indicates the nature of returns to scale. When expressed in logarithmic terms this function transforms into a linear function of the following type:

\[
\log Y = \log a + b_1 \log x_1 + b_2 \log x_2 \ldots + b_n \log x_n.
\]

Functions have been fitted for important crop enterprises as well as for the farm as a whole (gross returns), both for modernised and traditional Villages. With the help of this analysis the efficiency of resource use has been studied through the comparison of marginal value productivity of resources with their respective acquisition costs.

The significant differences between marginal value productivity of resources and their acquisition costs could be tested by computing 't' values. The formula for working out 't' is as follows:

\[
't' = \frac{MVP_i - P_i}{MVP_i^*}
\]

where, \(MVP_i\) is the marginal value product of ith resources and \(P_i\) is its acquisition cost.

If \(MVP_i - P_i \rightarrow 0\), it indicates that output could be maximised by increasing the use of ith resource. Thus it would be profitable to reduce the use of ith resource if \(MVP_i - P_i \not\rightarrow 0\).

*Standard error of marginal value productivity has been worked out by taking the square root of

\[
\left( \frac{\overline{Y/x}}{\overline{X}} \right)^2 \times V(b_i)
\]

where \(V(b_i)\) denotes variance of regression coefficient of \(x_i\).
Specification of Variables:

A great deal of caution is essential in the selection, classification and aggregation of input variables used in the production process for studying resource productivity. Different research workers have classified and aggregated farm inputs in different ways suitable for their studies. Various ways of classifying and aggregating input variables in production function studies together with a brief description of variables used as explanatory variables in the present study are given below:

Land:

Area is the most important explanatory variable used in the production function studies. It has either been used in physical units or in monetary terms. Agrawal, Basak and Choudhury, Saini, Shah and Zacharias used total area under crops as the unit of measurement of land.


Use of this input in physical terms may vitiate the results because simple acreage tends to ignore the fertility differences among and within the farms. To overcome this difficulty, Hanumantha Rao, Hopper, Khusro, Raj Krishna and Sen used standardised acres as unit of land either by taking land revenue or land value as an index of soil fertility.

In this study, area in acres has been used as explanatory variable. Although, there are differences in soil fertility within the village and also some difference among the villages, no effort could be made to control this soil difference, due to lack of information on that count. But the difference in fertility is not as great as to vitiate the results in any appreciable manner.

Bullock Labour:

Bullock labour used as single variable expressed in physical or value terms shows high multicollinearity with human labour. As such, Chaudhari

Driver and Desai, Hopper, and Radhakrishna have used it in terms of plough unit days consisting of one pair of animal labour day and one human labour day comprising one plough unit. But this also leaves out some of the human labour used with bullock labour. There are certain operations such as threshing where one human labour can work with one, two or three pairs of bullocks at a time.

As such bullock labour has been used as measurement of unit separately in this study. Here one bullock labour day means eight hours of work by one pair of bullocks.

**Human Labour:**

Human labour too, has been used as explanatory variable in the estimation of production functions either in physical units of time or in value terms. Naik and Shah used all human labour while Driver and Desai, Hopper and Mathur used all human labour except those associated with plough unit in value terms. Basak and Choudhury, Hanumantha Rao

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2) Hopper, W. D., *op. cit.*
5) Shah, S. L., *op. cit.*
7) Hopper, W. D., *op. cit.*
Raj Krishna, and Zacharias have used all human labour in terms of man days.

In the present study all human labour from land preparation to threshing has been used in terms of man days; one day consisting of eight hours of work per human labour.

**Manures and Fertilisers:**

Naik, Parikh and Shah have used chemical fertilisers as separate variable, while, Basak and Choudhury, Raj Krishna and Saini have included manures along with chemical fertilisers as an explanatory variable.

In the present study the value of manures and fertilisers together has been used as explanatory variable. In the course of investigation it was found that many farmers used not only home produced manures but also purchased manures and oil cakes. Some collect others' cattle and penn them on their fields to raise the fertility of the soil. Therefore, value of both organic and inorganic nutrients were clubbed together as an explanatory variable.

1) Raj Krishna, *op. cit.*
2) Zacharias, C. W. B., *op. cit.*
3) Naik, B. K., *op. cit.*
5) Shah, S. L., *op. cit.*
7) Raj Krishna, *op. cit.*
8) Saini, G. R., *op. cit.*
Plant Protection

In most of the studies this variable has not been included in the production function, because of the insignificant use of plant protection measures in the farms in the past. But after the adoption of the new technology, farmers have started using plant protection both as prophylactic and curative measures. In the present study area, plant protection has been used extensively by modernised farmers whereas its use is negligible on traditional farms and as such it has been included as an explanatory variable in the production function analysis for modernised farms only.

Caste

As has already been discussed in some detail there is a belief that the caste system is partly, if not wholly responsible for the low agricultural productivity in this area. Therefore, it would be interesting to introduce caste as an explanatory variable in the production function to see if it really plays any role in the production process.

It may be argued here that for a long time now caste as a socio-religious concept has been losing its sanctity. It may still have some significance in the social behaviour of different caste groups towards each other, but it does not play any role in the economic field. It is the ownership of the economic resources, that matters. This is evident from the fact that those castes which occupy the highest ladder in the socio-religious hierarchy in this area are considered to be backward castes in certain other parts of the country. A good example is that
of the Rajputs who are considered backward in Gujarat and Maharashtra, but occupy a higher position in Eastern U. P. and Bihar. Rajputs are considered equal to Jats in western U. P., whereas castes equivalent to Jats in Eastern U. P. are considered lower than Rajputs. These differences in social status reflect the differences in the ownership of economic resources, especially land in rural areas. Those castes who are economically dominant have come to occupy higher social status and vice-versa.

In Eastern U. P., the ownership of economic resources has been parallel with the social hierarchy. Brahmans and Rajputs who are highest in the caste order were the owners of bigger land holdings and are so even today as they continued to cultivate most of the land owned by them. Next came the traditional cultivating castes like Koiris, Ahirs etc. most of whom were fixed rate and occupancy tenants during British rule and as a caste come after Brahmans and Rajputs. The Harijans, who are the lowest in caste hierarchy have been traditionally agricultural labourers and were usually tenants-at-will during British rule, but today have some land after the Zamindari Abolition. It is quite evident that caste and ownership of economic resources are synonymous in this area; Brahmans and Rajputs who are highest in the social order have control over the major portion of the economic resources; Ahirs, Koiris etc. who come after Brahmans and Rajputs have control over some of the economic resources, but not as much as the higher castes and Harijans, who are
lowest in the social order control only a negligible portion of the economic resources.

Thus, it was felt necessary to include caste as an explanatory variable in the production function to see its influence in the production process. For this purpose castes have been divided into three categories namely, High Castes, Medium Castes and Low Castes.

**Use of Dummy Variables in Regression Equations:**

Dummy variables are usually associated with qualitative variables such as region, topography, occupation, caste, etc. It is a simple and useful method of introducing such variables into the regression analysis, which would otherwise be difficult to measure on a numerical scale.

Introduction of dummy variables into the regression analysis permits the separation of information on certain variables into discrete categories by assuming dummy values (0 or 1) for each of the categories.

To simplify the presentation suppose Y is the dependent variable gross returns in Rupees and the explanatory variables are \( x_1, x_2 \ldots x_n \). It is proposed to study not only the influence of \( x_1, x_2 \ldots x_n \) on Y but to see the effect of caste as well. Caste has been classified in three categories viz. High, Medium and Low based on the social hierarchy as prevalent in the area by convention. As such three dummy variables have to be defined with the property that \( D_i = 1 \) if the farm belongs to ith caste category, otherwise \( D_i = 0 \). If \( Y, x_1 x_2 \ldots x_n \) are in the log form, then define the dummy variables with the property that

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$D_i = e$, if the observation belongs to the $i$th caste category otherwise

$D_i = 1$. After introducing the dummy variables for caste categories, the regression model takes the following form:

$$Y = a + b_1 x_1 + b_2 x_2 + \ldots + b_n x_n + a_1 D_1 + a_2 D_2 + a_3 D_3 + W$$

The coefficients $D_1$, $D_2$ and $D_3$ are the estimated intercepts of High, Medium and Low castes respectively. If an attempt is made to estimate the parameters of this relationship by using the conventional computing program in which an intercept term is automatically computed, the estimation procedure breaks down because the appropriate matrix cannot be inverted.

In order to use the conventional computing program, one of the dummy variables (in this case low caste) has to be dropped. The effect of High and Medium Castes over the Low Caste is given by the regression coefficients of the included dummy variables in the model.

**Tenurial Conditions**

Tenurial conditions play an important role in the farm organisation and as such it has been included in the production function analysis as a variable in some studies. But it has not been included in this study as renting in and out of land is not very common in this area due to the prevailing land legislation and also due to smaller holdings (For a detailed account on tenurial conditions, see Appendix - II).

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1) Misra, V. N., *op. cit.*
Irrigation:

Assured and effective irrigation which has been one of the most important factors responsible for the adoption of new technology, should naturally find a place in the production function analysis. But it has not been included in the equation, owing to the difficulty in quantifying this variable. The number of irrigations would have been meaningless as it would not give the quantity of water applied. Even the quantity of water applied would not reveal the true picture as the timing of the irrigation is almost very crucial. In the absence of the limitation of the data, it has not been possible to include this variable in the equation.

Specification of Functions

Traditional Villages

Crop Enterprises: Functions have been fitted for important crops such as maize, local paddy, local wheat and barley grown in these villages. In all, four functions or models have been tried for all farms and also for different size groups, although the number of observations were not adequate for different size groups.

1) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 \]

2) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_4 \log x_4 \]

3) \[ \log Y = \log a + b_1 \log x_1 + b_3 \log x_3 + b_4 \log x_4 \]

4) \[ \log Y = \log a + b_1 \log x_1 + b_4 \log x_4 \]
Where,

\[ Y = \text{Yield of the main product in maunds} \]
\[ X_1 = \text{Area under the crop in acres} \]
\[ X_2 = \text{Human Labour days} \]
\[ X_3 = \text{Bullock Labour days} \]
\[ X_4 = \text{Value of manures and fertilisers in rupees} \]

**Aggregate Farm Enterprise**

For the analysis of aggregate farm enterprise five models have been fitted which are given below:

I) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 \]

II) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 \]

III) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_4 \log x_4 \]

IV) \[ \log Y = \log a + b_1 \log x_1 + b_3 \log x_3 + b_4 \log x_4 \]

V) \[ \log Y = \log a + b_1 \log x_1 + b_4 \log x_4 \]

Where,

\[ Y = \text{Gross returns in Rupees} \]
\[ X_1 = \text{Gross area in acres} \]
\[ X_2 = \text{Human Labour days} \]
\[ X_3 = \text{Bullock Labour days} \]
\[ X_4 = \text{Value manures and fertilisers} \]
\[ X_5 = \text{Dummy variable for High Caste} \]
\[ X_6 = \text{Dummy variable for Medium Caste} \]
Modernised Villages:

Crop Enterprises

In Modernised Villages farmers are taking High Yielding Varieties of Paddy and Wheat in addition to local varieties. Therefore, these two crops have also been added to the list of crops as included in Traditional Villages. In this way, maize, HYV Paddy, local Paddy, HYV Wheat, Local Wheat, and Barley have been taken for crop enterprise analysis. Functions were fitted size groupwise and for all farms. The following models have been used for the analysis of crop enterprises.

I) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 \]

II) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 \]

III) \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_4 \log x_4 + b_5 \log x_5 \]

IV) \[ \log Y = \log a + b_1 \log x_1 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 \]

V) \[ \log Y = \log a + b_1 \log x_1 + b_4 \log x_4 \]

Where,

\( Y \) = Yield of the main produce in maunds.

\( X_1 \) = Area under the crop in acres.

\( X_2 \) = Human Labour days.

\( X_3 \) = Bullock Labour days.

\( X_4 \) = Value of manures and fertilizers.

\( X_5 \) = Value of plant protection for only those crops where plant protection has been used.
**Aggregate Farm Enterprise**

For studying resource productivity at the aggregate farm level six functions have been fitted as given below:

I. \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 + b_7 \log x_7 \]

II. \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 \]

III. \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 \]

IV. \[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 \]

V. \[ \log Y = \log a + b_1 \log x_1 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 \]

VI. \[ \log Y = \log a + b_1 \log x_1 + b_4 \log x_4 \]

where,

- \( Y \) = Gross returns in Rupees
- \( x_1 \) = Gross Area in acres
- \( x_2 \) = Human Labour days
- \( x_3 \) = Bullock Labour days
- \( x_4 \) = Value of manures and Fertilisers
- \( x_5 \) = Value of Plant protection
- \( x_6 \) = Dummy variable for high caste
- \( x_7 \) = Dummy variable for medium caste.

In addition to the introduction of Caste as dummy variable in Model-I for aggregate farm enterprise in both sets of villages, caste-wise production function analysis has also been done.
The parameters to be estimated for the different functions mentioned above are \( \log a \), the constant term of the equation and \( b_1, b_2, \ldots, b_n \), the production elasticities of respective inputs. Simple correlation matrices have been worked out for all the variables for individual crop enterprises and gross returns for both the modernized and traditional villages which are given in the Appendix - IV.

**Modernisation Index**

In addition to the comparative study of Modernised and Traditional farms, it is the objective of this study to measure, if possible, the extent of Modernisation and also to identify the factors that are responsible for different levels of Modernisation in the same area.

With the above objective in view, it was imperative to somehow evolve some measure of modernisation. From the observation in the field, obvious changes that have occurred on the farm were studied. The new technology which is based on assured irrigation has resulted in: (1) stepping up of cropping intensity; (2) larger area under High Yielding Varieties; (3) increase in the per acre use of fertiliser; (4) increased expenditure per acre on plant protection measures; (5) area brought under new crops which were hitherto not grown in the area such as Berseem, Summer Pulses, etc.; and (6) capital investment in the shape of irrigation, ploughing and other farm equipment.

Therefore, cropping intensity, percentage area under High Yielding Varieties, per acre capital investment, per acre value of fertiliser and plant protection and percentage area under new crops was
computed for all the farms to construct an Index of Modernisation.

This new technology had been in operation for three years in this area at the time of the survey and as such at least 10 per cent of the farmers must have by then reached the highest level in the adoption of the characters chosen for Modernisation Index under the constraints of existing natural conditions of soil and climate, existing infrastructure, and technology which cannot be changed easily in the near future. The remaining 90 per cent can be expected or motivated to reach that level by removing the constraints - if possible - because of which they have remained at the levels they are. As such, the mean achievement of the top 10 per cent for each of the selected characters was computed and each was given a weight equal to 100. Again on the basis of this mean equal to 100 Indices were prepared for all the farms for each of the character. Then these indices were pooled for each farm and again the mean of the top 10 per cent was given a weight equal to 100. On the basis of this weight indices were prepared for all the farms.

The limitation of this type of Index is obvious because each of the characters do not contribute equally to the gross production. But in the absence of any a priori knowledge on the relative importance of

the characters, this appeared to be the only logical method. Further, in the initial stages a particular level of adoption of these characters has greater significance in bringing out the farmers from the traditional rut than knowing the relative contribution of each character in the production process. At this transitional stage it is important that these characteristics of Modernisation have been accepted and adopted by the farmers. Once the process is stabilised, studies can be conducted to find out the specific contribution of each character. Moreover, by reducing these characteristics to percentages and/or per acre, the dominance of area has been removed. Almost the same method was applied in the selection of villages, and its statistical validity was also established.

For identifying the factors responsible for different levels of modernisation regression analysis has been done. For this purpose a linear type of regression equation has been used as it is assumed that the relationship will be linear in the initial stages of modernisation. The regression equation used for this study is given below:

\[ Y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 \]

Where,

\( Y \) = The modernisation index

\( x_1 \) = Net area cultivated in acres

\( x_2 \) = Education of the farmer - Number of years in school

\( x_3 \) = Outside Income - Off farm - during the year

\( x_4 \) = Farmers age in years

\( x_5 \) = Dummy variables for High Caste and

\( x_6 \) = Dummy variables for Medium Caste.
For each of the above variables, regression coefficients with their standard errors have been worked out.

The detailed analysis of the factors responsible for the different levels of modernisation and also the impact of the level of modernisation on farm structure, input use, farm business income etc. have been given in Chapter - VI.