CHAPTER-I

SOURCES OF DATA AND RESEARCH METHODOLOGY

The input-output data used in the present study have been obtained from the Annual Publications of Socio-economic Branch of the Department of Agriculture, Government of West Bengal. The data for the farms in both the periods have been collected for the same districts of West Bengal. The districts are Burdwan, Hoogly, Birbhum, the 24-Parganas and Nadia. The first three districts lie on the Western Bank of the Bhagirathi while the last two districts are located on the east of the river. The entire region has generally been brought under irrigation, the eastern districts having tube-well irrigation, while the Western districts are in the canal zone. These districts possess some homogeneity as all of them belong to the Gangetic part of West Bengal with more or less common soil and climatic conditions.

In Period-I, the 240 farms were divided equally on the basis of being 'treated' and 'non-treated'. Of the 240 farms, 120 farms were 'treated' farms and the remaining 120 farms were 'non-treated' farms. Of the 120 farms in each group 32 farms were in Burdwan, 16 farms in Hoogly, and 24 farms each in Birbhum, the 24-Parganas and Nadia. On the other hand, in Period-II of the total 256 farms, Burdwan and 24-Parganas each had 40 farms, Hoogly and Birbhum each 72 farms and Nadia had 32 farms.
The villages were selected on the basis of their being representative of the areas in which they were situated. In selecting villages the characteristics such as the size of the village and willingness of villagers to co-operate were taken into consideration. The villages selected were all accessible throughout the year. This was done in the interest of close observations. Thirty villages were selected at the rate of six in each district except Burdwan and Hoogly. Burdwan being a large district eight villages were selected there. In the same way, Hoogly being smaller than the average district only four villages were selected from this district. One centre was set up in each district so that each centre covered six villages. The farmers were selected on the basis of their size of holdings and their willingness to co-operate.

We have first grouped the farms covered by the continuous farm management studies of the Government of West Bengal into two groups one having large and the other small farms for fitting production functions. Again, we have also grouped the farms into 'purely owned' and 'owned-cum-tenanted' farms to estimate production functions for 'purely owned' and 'owned-cum-tenanted' farms. It may be repeated that production functions have also been estimated for all farms taken together as well. In the case of farm costs and returns we have followed a classification into six size-groups.
The size groups are:

A. farms upto 2.50 acres
B. farms from 2.51 to 3.75 acres
C. farms from 3.76 to 5.00 acres
(d) farms from 5.01 to 7.50 acres
(e) farms from 7.51 to 10.00 acres
(f) farms from and above 10.00 acres

A number of techniques were followed to estimate the different aspects of the present study. The estimates of the production elasticities and other related statistics of the production functions have been made by applying multiple regression techniques to the input output data. The production relationship between an output \( Y \) and inputs \( X_1, X_2, \ldots, X_k \) has been postulated as the following equation model.

\[
\log Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \cdots + \beta_k \log X_k \quad (1)
\]

Regarding equation (1) as a regression law, \( Y \) is termed the dependent variable. The explanatory factors \( X_1, X_2, \ldots, X_k \) are independent variables. The parameters \( \beta_0, \beta_1, \ldots, \beta_k \) are the population regression co-efficients. From a mathematical viewpoint, given the correctness of the single equation model, equation (1) may be described as a continuous unilateral causal
relationship. In such terms Y is the effect variable and X₁, X₂, ..., Xₖ the causal factors. We determine the values of the parameters. If these values are known, the economic implications of the production function may be ascertained and applied in the real world. Thus, interest is in the causal relation as a whole, especially the β's and not just in the values of Y that may be estimated by using the equation. Provided that some basic assumptions hold true, the fact that equation (1) is linear in the parameters makes estimation of these parameters by multiple regression rather straightforward. All that is required is a sample of n > k + 1 sets of data showing the values of Y for various levels of each of the independent variables.

The sums of the co-efficients (estimated for different functions) have been statistically examined. In fact, for rigorous interpretation of the sum of elasticities (S = E ++ βₖ) one needs the standard error of the sum. The following is the procedure followed to estimate the standard error of the sum. We have first estimated (X'X)⁻¹ matrix and then added all the values of (X'X)⁻¹ matrix. The sum was then, multiplied by $\sum_2$ to obtain $V(S)$, where

\[ \sigma^2 = \frac{\text{Residual sum of squares}}{\text{Number of observations} - \text{Parameters}} \]

The square root of variance, $V(S)$ was the standard error of the sum. Lastly, we calculated $\tau (\text{tau})$, $\tau = \frac{\sum E}{\sum_2 (S)}$, where $\sum E$ is the
sum of the co-efficients and Sd(S) is the standard error of the sum. And we checked if $|t| \geq$ the critical value of 't for the appropriate no of degrees of freedom. If $|t|$ was less than the critical value of 't then we considered that the sum was not significantly different from one and this suggested the constant returns to scale to operate. On the other hand, if $|t| >$ the critical value of 't, then we considered that the estimated sum was significantly different from one and in that case the hypothesis $\beta_1 = 1$ was rejected.

Based on the estimated production functions, we have computed the values for the marginal products of the different inputs. The procedure followed to compute the values for the marginal products is as follows. Supposing we are fitting the relation
\[ \log Q = c + \alpha \log L + \beta \log K, \]
where $L$ is labour and $K$ is capital. This gives us $\log Q$ for any combination of $L$ and $K$. We can put for $L$ the geometric mean of $L$ and for $K$ the geometric mean of $K$. We get $\log Q$ from the relation. Taking anti-log, we get $Q$ corresponding to the geometric mean of $L$ and geometric mean of $K$.

Since $Q = \text{constant}$ for $L$ and $K$, we have marginal product of $L = \alpha \cdot Q$.

We compute this as $\frac{\partial}{\partial L} Q \cdot \text{g.m. of } L \times Q \cdot \text{g.m. of } K$ (for g.m. of $L$, g.m. of $K$).

In the same way, marginal product of $K$ is $\frac{\partial}{\partial K} Q \cdot \text{g.m. of } K \times Q \cdot \text{g.m. of } L$ (for g.m. of $L$, g.m. of $K$).
Another important technique adopted in the present study is to compute $|t|$ value for difference between the corresponding production elasticities for two groups of farms. The standard errors of the estimates are used to compute $|t|$ values between the corresponding production elasticities for two groups of farms. As for example, the estimate and standard error of $\beta_1$ for one group of farms are 0.3966 and 0.0742 respectively. In the same way, the estimate and standard error of $\beta_1$ for another group of farms are 0.2728 and 0.0754 respectively. To compare $\hat{\beta}_1$ in the two groups of farms, we compute $|t| = \frac{0.3966 - 0.2728}{\sqrt{(0.0742)^2 + (0.0754)^2}}$. Since $|t| < 1.96$, the difference is not significant at 5% level. Hence, $\hat{\beta}_1$ is not significantly different for the two groups of farms. This simple large sample test may be open to some criticism but should be sufficient for practical purposes.

In addition to the production function estimates, the present study is also concerned with farm size and efficiency and ownership pattern and efficiency. The figures of net income per acre of land have been computed by deducting the total per acre costs for seeds, manures & fertilizers, irrigation water, feed of bullocks and depreciation of tools and implements from gross-output per acre. The net value, thus, arrived at consists of the returns to land, labour capital and management owned and paid for. The net income per acre, thus arrived at, has been used as a measure of land use...
efficiency in the present study. This concept of efficiency, though partial, is meaningful in the present day Indian condition explained in the relevant chapter.

A few explanatory notes are given below in connection with the method of arriving at various cost items followed by the Socio-economic Evaluation Branch, Department of Agriculture, Government of West Bengal. The present study has followed this practice.

- **Seed**: Actual price of if homegrown the prevailing rate was considered.
- **Manures**: The cowdung was charged at Rs.0.25 per m.d. as uniform rate. The above price was found to be reasonable after enquiry.
- **Fertilizers**: Actual price paid.
- **Irrigation**: The irrigation rates were fixed for canal and tube-well have been charged.
- **Bullock-powers**: The figures on bullock-power included labour charges (both family and hired) for the upkeep of animals. In respect of homegrown feed staff the market rate was charged while purchased feeds was charged at the actual prices paid. In respect of some minor feed items as green grass, banana leaves etc, the actual cost of labour used in collecting these have been charged.
Depreciation of tools and implements: This has been calculated in respect of livestock equipment, houses, and small tools. The rate of depreciation was fixed for each item separately on the length of its life. The annual cost of implement was also calculated from expenses incurred varied according to the life of the implements.

Wages of hired labour: Actual wages paid were charged. Where food and tobacco were provided the money value of such payments in kind was added to the cash paid. Permanent labour was considered as hired labour. The total cash paid was added to the value of whatever was paid in kind. The total, thus, paid divided by the number of days to arrive at the daily wage rate. In cases where such permanent labour did non-agricultural work the labour was added to the agricultural labour to arrive at the daily wage rate. The permanent labour was paid clothes, towels, oils etc. in addition to what was paid to him in cash.

Family labour: Family labour was charged at the rate prevailing within the village of similar casual labour. But this wage rate varies from month to month. In working out cost of family labour each months' labour put in was multiplied by the mean wage rate of that month.
Interest on Capital

Rent on lands leased-in

Interest has been charged at the rate of 5 per cent. In our study we have included the interest on borrowed capital. This has been arrived at by deducting 12 per cent of total capital and multiplying it by the interest rate of 5 per cent. The 12 per cent deduction has been made on the basis of a study by the Reserve Bank of India that the farmers in the region supply about 12 per cent of their capital requirements.

Actual cash rent payable has been charged.

The share croppers pay rent in kind for the area taken on lease. The value of crops thus made over to the landlord owner is the rent in kind for the entire farm.