Chapter II

Review of Literature and Methodology
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REVIEW OF LITERATURE AND THE METHODOLOGY

This chapter presents the major findings of some of the related studies undertaken in India and other countries, using similar methodology. The past literature helps one to adopt, modify and improve the conceptual framework and also acts as a guideline for the researcher.

2.1 REVIEW OF LITERATURE

A review of the earlier studies on issues relevant to the research problem undertaken is attempted here and is organised as under:

i) Studies Relating to Agricultural Credit and

ii) Studies Relating to Cost and Returns.

i) Studies Relating to Agricultural Credit

Various studies have already been made relating to agricultural credit. Some of the more important among the available studies in this regard have been critically reviewed in the following pages.
Herrick considered credit as that form of confidence reposed in a person to enable him to obtain another the temporary use of a thing of value\(^1\).

According to Nicholson, the main purpose for which an agriculturist needed money was to pay for current cultivation expenses and for family expenses. The agricultural credit was not only essential but was also inevitable for the farmers and as such it should be considered neither as objectionable nor as a sign of weakness\(^2\).

Studies conducted by C. Clerk indicated that there was a positive correlation between the credit requirements and the improved techniques\(^3\).

Bedi and Saxena had found that the inadequate and untimely provision of credit had influenced adversely the responses of the Punjab farmers towards improved agricultural practices\(^4\).

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\(^1\) J. Herrick, *Rural Credit*, Asia Publishing House, Bombay, 1953, pp.3-10.
Chowdhery had discovered that the credit requirements of the farmers were of different types and were for different purposes. For example the seasonal credit needs were for meeting the various current input requirements such as for the purchase of seeds, fertilizers and pesticides; medium term credit requirements were for the purchase of seeds, drills, sprayers and the like and long term credit needs were for purchases such as levelling of land for the construction of cattle sheds and the like\textsuperscript{5}.

Rajagopalan had defined agricultural credit as the amount of investment funds that could be made available for farm production from sources outside that of the farm. He had also defined agricultural credit as the amount of investment funds that could be made available for the purpose of development and sustenance of farm production and productivity\textsuperscript{6}.

Bhagava and Shah had pointed out that the credit needs of the farmers consisted of the purchase of credit for fertilizers, for hired labour, for pumpset, for land reclamation, for machinery and for agricultural


equipments. The adoption of new technology was capital intensive in nature which would lead to a mainfold increase in the credit demanded\textsuperscript{7}.

Desai and Tambad had indicated that a high proportion of the farmers were eager to obtain credit at low rates of interest as also with an extended payment period\textsuperscript{8}.

Alhavale et.al., reported that the co-opertive credit was used mainly for the purchase of seeds, fertilizers and pesticides. For the other input, farmers usually relied on their own funds\textsuperscript{9}.

The Reserve Bank of India viewed credit as the amounts made available to the agriculturists for developing the farm and for meeting their cultivation, domestic or marketing expenses, to be repaid with interest at a later date\textsuperscript{10}.


Sharma and Prasad had felt that credit, in addition to savings, was an important source for meeting the ever increasing capital needs of agriculture\textsuperscript{11}.

Garg had made an attempt to estimate the credit requirements of farmers in the changed pattern of agriculture and had concluded that the provision of credit had helped not only in increasing the total farm production and the income of the farmers but also in increasing the rate of growth of the national economy\textsuperscript{12}.

Subramaniyan and Patel in their study in Andra Pradesh had concluded that credit had helped all the size groups of farmers to increase their net farm incomes in the various different zones\textsuperscript{13}.

\begin{flushright}
\textsuperscript{13}K.V. Subramaniyan and R.K. Petel, “Impact of Capital Availability on Farm Income and Demand for Short term credit in West Godavari District, Andhra Pradesh”, \textit{Agricultural Situation in India}, Vol.28, No.3, 1973, pp.149-152.
\end{flushright}
Shukla and Mishra in their study on credit in Uttar Pradesh had concluded that there was a positive impact of the co-operative finance on the levels of input, income and employment\textsuperscript{14}.

Yadava \textit{et. al.}, found that the adopting of the improved agricultural technology required greater amounts of money by way of investment. It was more so in the case of the small farmers who were frequently confronted with the problem of scarce resources. The study showed that all the small farmers studied required credit\textsuperscript{15}.

Singh et al., attempted to study the impact of credit on farmers by comparing the beneficiaries and non-beneficiaries with the helps of a few indicators such as the cropping pattern and the cropping intensity and they had indicated that there was a more significant development in the case of the beneficiaries’s as compared with non-beneficiaries’s\textsuperscript{16}.


Sharma and Prasad had studied the credit needs of the farmers of different farm sizes and of different regions and at different stages of technological development in agriculture. The study had revealed that irrigated farms and farms which had already adopted improved technology required far more credit. Provision of adequate credit had increased the incomes of the farmers substantially even at the existing levels of technology\textsuperscript{17}.

Misra had found that provision of short-term credit and made a more favourable impact on the output of major crops, like paddy, wheat and sugarcane. The study had revealed that there was also much scope for increasing the medium and the long term advances to farmers\textsuperscript{18}.

Lavania had studied the impact of bank finance on agricultural incomes and yields, and he had found that the farmers augmented their


yields and their net incomes from their major crops through improved technology and by the availability of short term and medium term loans\textsuperscript{19}.

Ramadass had studied the demand for and the productivity of the provision of farm credit in the Pondicherry region. This study had found that farm credit had a positive and significant impact on the productivity of the small and the medium farms\textsuperscript{20}.

Kulwant Singh in his work entitled “Co-operative Agricultural Credit Utilisation in Himachal Pradesh” had analysed and concluded that in recent years, the requirements of agricultural credit had assumed significant dimensions due to the increasing thrust in the development of new technology in the agricultural sector\textsuperscript{21}.

Agricultural credit, according to G. Malvin Blasé, was a powerful economic force to achieve development if it was used to inject appropriate


\textsuperscript{20}M. Ramdass, “Demand for and Productivity of Farm Credit in Pondicherry Region – An Economic Appraisal” 1978.  

inputs into agriculture, that were otherwise not possible for the farmers to provide from their own financial, physical and labour resources\textsuperscript{22}.

According to Sharma and Prasad, credit in addition to savings was an important source of meeting the ever increasing capital needs of agriculture. This included both the variable and the fixed capital expenditure needs of the farmers\textsuperscript{23}.

According to P.K. Banerjee, credit needs for small farmers were generally the expression used to denote the short-term credit requirements of the farmers. Agricultural credit was the most urgently needed resource for the small farmers. Not only their operational efficiency but their very survival depended upon the flow of agricultural investment\textsuperscript{24}.

S.S. Johi and B.P. Singh had found that in Punjab, the government and the co-operative institutions were not meeting the full requirements of the development finance required by the farms\textsuperscript{25}.

According to J.S. Sharma and B. Prasad, credit in addition to savings was an important source for meeting the increasing capital needs of agriculture\textsuperscript{26}.

E.F. Rawat had felt that credit was an important input in the production process either in agriculture or in the industrial sector\textsuperscript{27}.

Chitranjan was of the view that creditworthiness could also be improved by increasing the application of production techniques which resulted in saving land and using more of labour using as the small and the marginal farmers had abundance of labour and scarcity of land resources. Creditworthiness could also be improved by evolving a production pattern which was market oriented and biased against self-consumption. An obvious

implication of such an approach would be to encourage the small farmers and the marginal farmers to switch over to the cultivation of more and more of the cash crops\textsuperscript{28}.

According to K. Sain, Co-operative credit can also result in the upliftment of agriculture by encouraging the farmers to increase their own irrigation potential to enable them to use chemical fertilisers, high yielding varieties of seeds, pesticides and adopt the modern techniques so that they can adopt the multiple cropping patterns\textsuperscript{29}.

G.N. Singh had also reported that, on an average, about 73.71 per cent of the co-operative loans were utilised for productive purposes. As the size of the farm increased the utilisation of the loans had also increased\textsuperscript{30}.

The study undertaken by J.M. Mulani had revealed that the provision of co-operative agricultural credit in Gujarat had not only strengthened the

productive capacity of the small land holdings, but had also helped those small farmers in raising their standards of living\textsuperscript{31}.

Banker and Holcomb had believed that a farm in its operations would generate, besides income and assets, credit also and they had defined credit as the capacity to borrow or the ability to sell debt and thereby reap a rich dividend\textsuperscript{32}.

Meclichar Emmanual had argued that credit involved a temporary transfer of wealth and included the amounts provided by way of loans or advances, cash credit of advances, overdrafts or purchase of discount bills other than advances against security or by way of purchase of demand documentary bills, drawn in connection with the movement of a commodity\textsuperscript{33}.

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\textsuperscript{31}J.M. Mulani, “Co-operative Changes and face of Gujarat Villages”, \textit{Kissan World}, April 1988, p.27.


\textsuperscript{33}Melichar Emmanual “Farm Credit an Credit Projections”, \textit{Indian Journal of Agricultural Economics}, Vol.24, No.4, 1964, pp.117-137.
Dra Srivastava et al., had recommended that as far as possible credit should be advanced in kind, and the small and the medium farmers should be brought under the scheme of supervised credit.\textsuperscript{34}

Based on the experience of the U.S.A. and other developed countries, Pattle had argued, that where capital markets were not well-developed, the government must provide, at least in the initial years, most of the money required for the agricultural credit systems.\textsuperscript{35}

Singh and Misra had reported that the cultivators took loans from the different institutions, mainly for their irrigational structuring for the repayment of old debts, and for the purchase of manures fertilizers and seeds.\textsuperscript{36}


According to Hopkin et. al., agricultural finance referred to the acquiring and controlling of assets, ownership by way of cash purchase, borrowings, leasing in and custom hiring\(^{37}\).

Agrwal and Kumawat had proved that the provision of additional credit had increased the farm incomes even at the then existing levels of technology by 41 per cent, whereas the adoption of the new technology without additional credit had not resulted in any increase in the yield and the adoption of improved technology with additional capital in the form of credit had increased the farm incomes enormously\(^{38}\). Similar arguments had been advanced by Singh\(^{39}\), Subramanian\(^{40}\) and Pandy\(^{41}\).

A number of studies had considered credit as the investment of funds used in the farm, obtained from off farm sources, which was repayable in


future together with interest as agreed upon, either explicitly or implicitly and was a temporary measure of raising funds for defraying various obligations\textsuperscript{42}.

Srivastava had attempted to study the impact of farm credit with different levels of parameters. The study had disclosed a high positive marginal productivity of capital among all the groups of farmers who had utilised a less than optimum level of credit. The production of crops and the net profits had increased with every successive additional unit of credit\textsuperscript{43}.

Krishnasamy had assigned an important role to the framework of a multi-agency approach comprising co-operatives, the commercial banks and the Regional Rural Banks, in meeting the credit needs of the farmers\textsuperscript{44}.

Rawat had defined credit as an important input in the production process, both in agricultural as well as the industrial sector\textsuperscript{45}.

ii) Studies Relating to Cost and Returns

Dhareshwar\textsuperscript{46} stated that under Deccan conditions the income per acre of Basrai plantain would be more than Rs.1000, with expenses amounting to half as much.

Nayar\textsuperscript{47} estimated the cost of cultivation, receipt and net profit per acre of Nendran in parts of the west coast as Rs.810, Rs.1,450 and Rs.640 respectively.

The relationship between cost and returns is of vital importance in Indian agriculture. In agriculture operations, the cost of production refers to the expenditure incurred on the various inputs (both operational and fixed) to obtain the final produce. The cost of production consists of two parts, namely fixed cost and variable cost. In farm management studies, Shukla\textsuperscript{48} has categorised costs into cost $A_1$, cost $A_2$, Cost $B$, cost $C$. Cost $A_1$ includes the cost of seeds, manures and fertilizers, plant protection, livestock,

\textsuperscript{46}Dhareshwar, “Response of Basrai Banana to different Manures under Deccan Conditions”, \textit{Rural India}, Vol.156, 1952, p.74.
\textsuperscript{47}T.G. Nayar, \textit{Banana : Nendran}, Madras Agricultural Department, 1954, pp.21-35.
expenses, hired human labour, irrigation charges, land revenue, interest on working capital, depreciation, of fixed assets and miscellaneous expenses. Cost A₂ covers cost A₁ plus rent paid for leased in land. Cost B includes cost A₂ plus rental value of owned land plus interest on fixed capital minus land revenue on owned land. Cost C includes cost B plus imputed value of family labour.

The fixed cost includes depreciation, taxes, rent, interest and insurance premium. It results from past commitments of cost already sunk. It is constant overtime and does not vary with the changes in output. It exists even in the absence of cultivation. The variable cost covers wages paid to hired labour, cost of manures and fertilizers, cost of seed, tractor fuel and livestock feed. It varies with the changes in the levels of output. It does not exist in the absence of cultivation.

Hanson⁴⁹ in his study revealed that small farmers spent higher amount per hectare on the inputs. Chemical fertilizer as the highest input cost was incurred in the small and large farms, followed by the input, seed.

Sankara Ramalingam\textsuperscript{50} in his study, throws light on some of the important aspects of plantain cultivation. His study reveals the problems in plantain cultivation, types of plantain farms and their viability. His study deals with the various types of plantain cultivation and also analyses the market prices and market organisations and the export markets for plantain.

Rajagopalan\textsuperscript{51} in his study on the cost of production of crops in Tamil Nadu considered only Cost A (variable) and Cost C (fixed). Cost A included the following components:

i) Value of human including family labour
ii) Value of bullock labour
iii) Value of machinery charges
iv) Value of seed
v) Value of insecticides
vi) Value of manures of fertilizers
vii) Cost of irrigation and
viii) Interest on working capital


\textsuperscript{51} V. Rajagopalan, \textit{Studies on Cost of Production of Major Crops in Tamil Nadu}, Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, 1978, pp.2-3.
Cost C comprised cost A plus rent (including actual rent paid by the tenant or rental value of owned land), interest on fixed capital, land revenue, cess, taxes and depreciation of implements and machinery.

Arputharaj and Keasavan Nair\textsuperscript{52} in their study, found, on an average an amount of Rs.36,252 per hectare had been incurred towards cost of cultivation of plantain. The highest item of expenditure was human labour forming about 23 per cent of the total cultivation expenses. The average output per hectare was 14,991 kg. of plantain bunches valued at Rs.56,205. The benefit cost ratios at cost A1, A2 B and C worked out to 2.16, 2.10, 1.84 and 1.64 respectively.

Latha Bastine and Radhakrishnan\textsuperscript{53} in their study on ‘Economics of Plantain Cultivation in Kerala’ found the cost of cultivation per hectare was Rs.36,249. The returns worked out to Rs.45,068 and the net income was Rs.8,819. The main items of expenditure are the cost of both family and hired labour and manure per hectare of plantain cultivation. The study

\textsuperscript{52}C. Arputharaj and S. Kesavan Nair, \textit{Economics of Banana Cultivation in Kerala}, Himalaya Publications, New Delhi, 1986, pp.25-37.

showed that the contribution of family labour was 30.50 per cent of the total expenditure for labour. The contribution of family labour showed a decreasing trend as the size of holding increased.

Nirmala\textsuperscript{54} in her study on “Economic Analysis of Rice Cultivation” observed that female labourers were preferred for most of the farm activities. The small farmers incurred more expenses on labour employment compared to large farmers. The input-output ratio per acre in terms of operational cost of total cost was less for small farms than for large farms. The small farmers incurred higher cost of cultivation and obtained larger quantity of output per acre than the large farmers.

Haridoss\textsuperscript{55} concluded that in sugarcane cultivation, the returns per acre and net income of small farmers were higher than those of large farmers. Small farmers incurred higher cost of production and obtained larger yields per acre than large farmers.


Haridoss and Sannasi\textsuperscript{56} observed that the cost of production and output per acre in paddy cultivation on the small farms were higher than those in larger farms. The small farmer enjoyed greater monetary benefit than the large farmer due to better management techniques in the utilisation of inputs, constant watch, timely application of necessary inputs, concentrated involvement and better utilisation of the imputed inputs.

In the present study, the cost of cultivation of plantain is classified into cost A (operational cost) and Cost C (Cost A plus fixed cost). Cost A included (i) human labour including family labour (ii) bullock labour (iii) chemical fertilizer (iv) pesticides (v) sucker cost (seed) (vi) organic manure, (vii) cost of irrigation (viii) cost of propping and (ix) interest of working capital. Cost C included cost A plus rent and plus interest on fixed capital, excluding land revenue, cess and taxes and depreciation of machinery. In this study, Net Income was obtained after deducting cost C from the Gross Income.

2.2 METHODOLOGY

Designing a suitable methodology and the selection of proper analytical tools were important for a meaningful and useful analysis in any research undertaking. In this section, an attempt has been made to describe the methodology which included the reasons for the choice of the study area, the sample design, the period of study, the method adopted for the collection of data, the method of analysis and tools of analysis.

2.3 CHOICE OF THE STUDY AREA

The main aim of the study is to evaluate the impact of co-operative agricultural credit on capital formation, production and productivity with reference to the cultivation of banana, Thoothukudi district is one of the most important districts in Tamil Nadu where there has been significant agricultural development particularly in the banana cultivation since 1960. The main commercial crop in the district is banana and major export of banana in India is from this district. The soil and climatic conditions are highly favourable for banana cultivation. Hence, banana cultivation was found to be the predominant activity in this district as compared to the cultivation of other crops. There were 157 branches of the agricultural co-
operative banks which were distributing loans, for a vast majority of the farmers in this district. The functioning of the co-operative banks and their role in promoting agriculture development in this district were also found to be at a satisfactory level. These prevailing conditions had motivated the researcher to select this District and the banana crop for the purposes of the present study.

2.4 SAMPLE DESIGN

Stratified multi-stage proportionate random sampling technique has been adopted for the present study, taking Thoothukudi District as the Universe, the branches of the co-operative banks in the district as the stratum, the members of the co-operative banks as the primary unit and the banana cultivation members as the ultimate units.

In Thoothukudi District, there were 157 primary agricultures co-operative Banks and one Primary Land Development Bank which have been providing agricultural credit to the farmers; more particularly for the banana cultivators. A list of members from each of these banks was obtained from the records of the banks for the year 2001-02. All 157 co-operative banks in this district were arranged in descending order of members and the first 25
banks which accounted for more than 60 per cent of the members were selected for the present study. The proportionate probability sampling technique was used to select 300 member farmers from the 25 banks and they were randomly selected. The names of banks, the number of member-farmers in each of these banks and the number of the selected member farmers are furnished in Table 2-1.
**TABLE 2.1**

**NAME OF BANKS, NUMBER OF MEMBER FARMERS AND THE SAMPLE SIZE OF FARMERS (2001-02)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Banks</th>
<th>No. of Members</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EE 460 Singathakurichi, Srivaikuntam</td>
<td>1421</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>N.T.B.52 Sekkarakudi, Srivaikuntam</td>
<td>1318</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>EE 419 Peroor, Srivaikuntam (Taluk)</td>
<td>1307</td>
<td>16</td>
</tr>
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<td>4</td>
<td>0.570 Arumugamangalam, Srivaikuntam</td>
<td>1262</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>EE 444 Aniyabaranallur, Srivaikuntam</td>
<td>1257</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>EE 153 Sathankulam</td>
<td>1216</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
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<td>1178</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>EE 429 Athinathapuram, Tiruchendur</td>
<td>1154</td>
<td>14</td>
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<td>9</td>
<td>EE 455 Ambalaseri, Tiruchendur</td>
<td>1112</td>
<td>13</td>
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<td>12</td>
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<td>12</td>
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<td>12</td>
<td>EE 418 Arumuganeri, Tiruchendur</td>
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<td>TNS 79 T.Shanmugapuram, Kovilpatti</td>
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<td>16</td>
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<td>899</td>
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<td>9</td>
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<td>0.855 Mudiviothanendal, Srivaikuntam</td>
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<td>Total</td>
<td></td>
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<td>300</td>
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</table>
2.5 PERIOD OF STUDY

In order to study the performance of the banks in terms of the loans issued by them, their recovery performance, their outstanding and overdue position, data were collected for a period of ten years from 1990-91 to 2001-02. The field survey was conducted during 2001-02, for the purpose of collection of primary data. The reference period of the survey pertained to the agricultural year 2001-02.

2.6 COLLECTION OF DATA

Both primary and secondary data had been used for the present study. A reconnaissance survey was conducted by meeting the farmers, particularly paddy cultivators, so that the researcher may get fully acquainted with the various stages of agricultural operations, various kinds of investments made by the farmers and the actual farming conditions. On the basis of the information gathered, a well designed pre-tested interview schedule was prepared and used in the field survey for the collection of primary data. Before undertaking the main survey a tentative interview schedule was prepared and administered to 20 farmers on a pilot basis in order to test the correctness of the interview schedule. It helped the researcher to delete the
unwarranted questions and add a few relevant questions and the modified final schedule was prepared and used.

The selected farmers were contacted in person and the objectives of the study were clearly explained to them, and their co-operation was secured. The details regarding the characteristics of the sample farmer, his farm structure, the size of his holding his cropping pattern, his investment pattern in farm assets, his costs and returns, the net incomes received by him and the other aspects relating to the present study were collected from each of the sample farmers through the personal interview method.

Secondary sources of data relating to location, climate, rainfall, soil types, land utilisation patterns, yield and production of the major crops, the cropping pattern and the like were collected from the Office of District and Taluk Staticial offices. The data regarding the list of members, the loans issued, the outstandings, overdues and recoveries were collected from the records of the co-operative Banks.
2.7 METHOD OF ANALYSIS

Keeping in view the objectives of the study, the selected 300 sample member farmers were stratified into two categories, namely the beneficiaries groups and non-beneficiaries groups. For the purposes of the present study, the non-beneficiaries groups of farmers were the members of the co-operative banks who had not availed themselves of any loan facility from their bank as also from other banks. Out of the 300 sample farmers, 192 sample farmers were in the category of the beneficiaries group and the remaining 108 sample farmers were under the non-beneficiaries group. In each category, the sample farmers were divided into two groups, namely, the small farmers and the larger farmers, based on their area of banana cultivation. The farmers with less than 5 acres of banana cultivation were grouped as small farmers and the farmers with 5 acres or more than 5 acres of banana cultivation were grouped as the large farmers. Out of a sample of 192 farmers under the beneficiaries group, 131 (68.23 per cent) farmers came under the category of the small farmers and the remaining 61 farmers (31.77 per cent) fell under the category of the large farmers. In the on-beneficiaries group, out of the 108 sample farmers, 72 farmers (66.67 per
cent) belonged to the small size group and the remaining 36 farmers (33.33 per cent) belonged to the large size category of farmers.

2.8 TOOLS OF ANALYSIS

In order to analyse the trend and growth of the amounts of credit issued, recovered, and the amounts which fall in the category of outstandings and overdues, the following semi-log trend equation was fitted.

\[ \log Y = a + bt \]

where,

- \( Y \) represented the variable and
- \( T \) represented the time period.

To compute the compound growth rate, the following formula was used:

\[ \text{Compound Growth Rate (CGR)} = [(\text{Anti log } b-1) \times 100] \]

In order to assess the nature of the inequality in the distribution of per acre net income, mean, median, mode, standard derivation and the co-efficients of variation were used.
The extent of the inequality was measured with the help of the Lorenz Curve and the Gini co-efficient.

Lorenz curve was used to study the inequality in the deviation of the net incomes. The curve would fall entirely within the unit squares and the curve would coincide with the diagonal joining the points (0,0) and (1,1) if there was perfect equality. If the curve was farther and farther away from the diagonal, it would disclose a greater and greater inequality.

In order to study the degree of inequality in the per acre incomes of the farmers the following equation was used.

\[ G = 1 + \frac{1}{n} - 2 \cdot n^2 \cdot y \{ n \cdot Y_1 + (n-1) \cdot Y_2 - 2 \cdot Y_{n-1} + Y_n \} \]

where

- \( N \) represented the number of individuals,
- \( Y \) represented the per acre value of the net incomes of the individuals farmers
- \( Y_1 < Y_2 \ldots Y_{n-1} < Y_n \)
- \( \bar{Y} \) represented the net income

In order to assess the impact of credit on production, the following form of the Cobb-Douglas type of production function was used.
\[
\log Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + u
\]

where,

\[
Y = \text{Per acre value of output (Gross returns) including by-products in rupees,}
X_1 = \text{Per acre value of the fixed capital in rupees,}
X_2 = \text{Per acre cost of labour in rupees,}
X_3 = \text{Per acre value of working capital in rupees,}
X_4 = \text{Per acre value of agricultural credit in rupees,}
U = \text{Disturbance term and}
\]

\[
\beta_0, \beta_1, \ldots, \beta_4 \text{ are the parameters to be estimated.}
\]

To examine the structural differences between the beneficiaries’ and the non-beneficiaries’ groups of farmer, the following form of a model was estimated by the method of least squares separately, for the beneficiaries’ group, the non-beneficiaries’ group and for the pooled total category of the sample farmers.

\[
\log Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + u
\]

where,

\[
Y, X_1, X_2 \text{ and } X_3 \text{ are as indicated in the model}
\]
The structural differences were examined by testing the equality of the parameters of the regression models estimated for the beneficiaries' and the non-beneficiaries' and following form of Chow's F-test was carried out.

\[
F = \frac{\Sigma e_2 - (\Sigma e_1^2 + \Sigma e_2^2)}{\Sigma e_1^2 + \Sigma e_2^2} \cdot \frac{n_1 + n_2 - 2k}{k}
\]

where

\[\Sigma e_2 = \text{unexplained or residual sum of squares of the pooled sample of both the beneficiaries’ and non-beneficiaries’ groups of farmers,}\]

\[\Sigma e_1^2 = \text{unexplained or residual sum of squares of the sample corresponding to the beneficiaries’ groups,}\]

\[\Sigma e_2^2 = \text{unexplained or residual sum of squares of the sample corresponding to the non-beneficiaries’ groups,}\]

\[K = \text{the number of parameters included in the regression model,}\]

\[N_1 = \text{sample size of the beneficiaries’ groups,}\]

\[N_2 = \text{sample size of the non-beneficiaries’ groups.}\]

In the case of structural differences the credit dummy was introduced at the intercept level in the regression model.
The regression model became

$$\log Y = \beta_0 + \alpha D \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + u$$

where,

where $D = 1$ if the sample farmer is a beneficiaries'  

$= 0$ otherwise.

The above equation was estimated by the method of least squares.

The regression co-efficient of different inputs estimated from the different regression models could be used to compute the returns to scale also. The returns to scale were either increasing remained constant or were decreasing according as, the sum of the regression co-efficients were greater than, equal to or were less than unity.

But one should be more concerned with the results which were based upon statistical tests rather than upon the rough summary results. According to Singh, the statistical test should be as follow:
\[ t = \frac{\Sigma \beta_i - 1}{SE(\Sigma \beta_i)} \]

where

\[ \Sigma \beta_i = \text{Sum of the co-efficients} \]

\[ SE = \text{Standard Error}. \]

2.9 MULTICOLLINEARITY

Before entering into an analysis of the regression model, the foremost and most important task of the researcher was to test the multi collinearity or perfect linear relationship, among some or all the explanatory variables. For this, Heady-Dillon test was applied. This test which was based on the Zero Order Correlation matrix is given in Appendix II (Tables A1 to A4). It showed that the simple correlation coefficients between the explanatory variables was found to be statistically not significant. This indicated the absence of multicollinearity in the estimated regression model on the types of farmers, namely, the beneficiaries’, the non-beneficiaries’ and of the beneficiaries’ group according to different sizes.