CHAPTER V

SUMMARY AND CONCLUSIONS
CHAPTER-V
SUMMARY AND CONCLUSIONS

During the last five decades of planned economic development in India, there has been considerable improvement in the Indian economy especially in the agricultural sector. However, the production of cereals have received a major set back and there is a declining trend in the production and productivity of these low value crops. Facts clearly reveals that despite the adoption of improved farm practices viz., use of HYV seed, chemical fertilizer, pesticides and pest control measures, productivity of crops in general showed a decline across farms and regions. In Indian agriculture, it is observed that some of the crucial resources are either under utilized or over utilized in the crop production. Further, the availability of farm resources and their pattern of utilisation are not the same all over the country. Therefore, estimations on the optimum allocation of certain resources are necessary for the steady growth of agricultural production and productivity. More specifically, evaluations on the optimum use of resources like land, human labour, bullock labour, fertilizers, irrigation, seeds and working capital etc, at farm levels, are needed for streamlining agricultural operations to a commercially viable one at regional levels. In this context, estimation of technical efficiencies assumed importance especially at farm level decisions. In other words, the concept of efficiency is at the core of economic theory and the whole of production economics is concerned with the issue of optimisation which implies efficiency. It is not surprise that considerable
The primary objective of the study was to examine the Resource Use Efficiency of crop farms cultivating HYV paddy and sugarcane in the two principal Ayacuts of the Bhavani River Basin in Tamil Nadu. For the purpose of the study Erode District form the universe of the study. Purposive-cum two stage stratified random sampling technique was employed to select samples. Data relating to the various aspect of the survey method covering the crop period 2004-05 were collected through personal survey method using a pre-

tested schedule. A tabular and percentage analysis were used to examine the socio-economic characteristics and the economic aspects of crop production by farm size groups. In order to estimate the average contribution of different inputs to output, the Cobb-Douglas Production Function using Ordinary Least Squares techniques was employed. Stochastic Frontier Production Function of the Cobb-Douglas types was specified to estimate the technical efficiency of individual farms and crops for the selected areas.

The stochastic frontier production function of the following type was specified.

\[
\ln Y = \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + v_i - u_i
\]

Where,

- \( Y_i \) = Actual output of the \( i^{th} \) farm in quintals/tonnes
- \( \alpha \) = Constant term
- \( X_1 \) = Area under the crop in acres
- \( X_2 \) = Quantity of seed in Rs.
- \( X_3 \) = Family labour used in man-days
- \( X_4 \) = Hired labour used in man-days
- \( X_5 \) = No. of machine hours used
- \( X_6 \) = Quantity of chemical fertilizer (NPK) used in kgs
- \( X_7 \) = Amount spent on pesticide components (in Rs.)
- \( \beta_i \) = Unknown parameters to be estimated
- \( v_i \) = Symmetric component of the error term and
- \( u_i \) = non-negative random variable which is under the control of the farm.

'U' takes the value of zero when the farmer is efficient and assumes the value greater than zero when the farmer is inefficient. The Maximum
Likelihood Estimation (MLE) method enables us to obtain the maximum possible output function. It is also assumed that $u$ and $v$ are independent and $u$ follows a half normal distribution with variance $\sigma_u^2$ and $v$ follows a normal distribution $N \sim (\mu, \sigma_v^2)$.

The frontier 4.1 software (Collei-1996) was used to estimate the frontier and farm-specific technical efficiencies.

**DETERMINANTS OF TECHNICAL EFFICIENCY**

The influence of socio-economic and farm characteristics of the selected sample farmer households were examined on the technical efficiency. Variables, such as age, education, family size, and farm size were considered in the model. The technical efficiency scores generated through MLE are regressed on the above variables as presented below,

$$TE_{ij} = \alpha + \alpha_1 (AGE) + \alpha_2 (EDU) + \alpha_3 (FMIS) + \alpha_4 (FARMS) + e_i$$

Where,

- $TE_{ij}$ = Technical Efficiency of $i$-th crop on $j$-th farm
- $\alpha$ = Regression Co-efficient
- $AGE$ = Age of the farmer household
- $EDU$ = Educational status
- $FMIS$ = Family size
- $FARMS$ = Farm size
- $e_i$ = error term

The influence of socio-economic and farm characteristics of the selected sample farmer households were examined on the technical efficiency, using Cobb-Douglas Production Function methodology, through maximum likelihood estimation method.

---

93 Ibid P.181
The major findings of the study are presented in three main parts viz.,
i) Socio-economic characteristics of the sample farm households, ii) Cost and
return of paddy and sugarcane production and iii) Technical Efficiency of
crop production among the farms of varying size group in Erode District of
Tamil Nadu.

The analysis of the socio-economic characteristics of the selected
sample households reveals the fact that out of the total 480 sample
households farmers, 21.7 percent of them were in the age group between 20-
39 years, 65.5 percent were between 40-59 years, and 12.7 percent were in
the age group of above 60 years, which clearly indicates the fact that farming
operations in the area were confined largely to the farmers in the age group of
40-59 years.

The educational status of selected sample households of different farm
size group revealed that out of 480 sample households farmers, 20 percent of
them were illiterates, 18 percent were at primary level, 40 percent were at
secondary level and 22 percent had education at higher secondary level and
above, which clearly indicates the fact that an average of 40 percent of the
sample farmer households had education above higher secondary level, which
had a definite implication on farm level decision making.

With the respect of the family size-wise distribution of the sample
households, out of the 480 sample households of different farm size groups
selected for the study, 3.75 percent were with the family size of below 2
members, 50 percent were with the family size of 2-4 members, 39.37
percent were with the family size of 4-6 members and 6.88 percent of the households had family size of above 6 members. The inter group comparison among the different farm size groups reveals the fact that, the average family size for the area chosen falls in the category 2-4 members.

**ANALYSIS OF COST AND RETURN**

From the point of view of the analysis of costs and return of the paddy among the selected sample farmers from Thadappalli ayacut areas, the average paddy cultivating farmer in the area ought to spent an average of about 33 percent of the total cost towards family labour cost followed by hired labor (27.77 percent). Higher proportion of family labour might be due to their excessive participation in farm activities. This may be either due to the fact of higher family size recorded or non availability of hired labour in the region. From the point of view of pesticide use, higher proportion of cost was accounted for the farms of below 2.5 acres, while it was on the reverse for farms of above 2.5 acres. The proportion of fertilizer cost tended to increase with farm size, while the proportion of pesticide cost tended to diminish with farm size. The net revenue worked out for different size group of farms cultivating HYV paddy in the area tended to increase with farm size upto 7.5 acres showed a marginal decline for farms of above 7.5 acres. Negative return registered for net revenue to farms of < 5 acres might be due to the excessive use of family labour and pesticide over other farms as well as the higher capital cost appropriated. However, from the point of view of the
return over variable cost, all farms except in the group of <2.5 acres were witnessed with positive odds.

In the case of sugarcane cultivation, in this area an average sugarcane cultivating farmer had spent 14.40 percent of the total cost on seed, 5.32 percent on family labour, 64.96 percent on hired labour, 5.67 percent on machinery used, 6.04 percent on fertilizer and 3.61 percent on pesticide. In other words, of the cost constituents, the share of hired labour was recorded to be the maximum, indicating the fact that sugarcane production in the area was largely dependent upon hired labour. Cost on seed occupied the second important position in the cost of cultivation of sugarcane. The general observation of small farms containing with large scale family labour force participation was found absent, while the trend of increasing hired labour cost with farm size was witnessed. From the point of view of net return, which tended to increase with farm size upto 7.5 acres, while decline in net revenue was recorded for farms of above 7.5 acres. This might be due to the fact that the benefit of economics of scale has reached its maximum with the farm size of 5.0-7.5 acres. Though paddy and sugarcane production in Thadappalli ayacut areas are taken place simultaneously and treated as alternative operations, from the point of view of revenue over variable cost, adoption of sugarcane cultivation seemed to be more beneficial than paddy provided if the socio-economic and agro-climatic conditions of the farm sector is assumed to be given.
The important constituents of cost incurred for the cultivation of paddy in the Lower Bhavani Project (LBP) ayacut were seed, family labour, hired labour, machine hours used, chemical fertilizer application and pesticide. The family labour force participation among paddy farms were 52.19 percent, 43.58 percent, 35.14 percent and 27.85 percent respectively for farms of <2.5 acres, 2.5-5.0 acres, 5.0-7.5 acres and >7.5 acres; it was 17.39 percent, 19.55 percent, 25.84 percent and 31.92 percent respectively towards hired labour cost. In other words, the family labour participation for farms tended to decrease with farm size; while increasing trend was observed with farm size. The cost of fertilizer was recorded to be on the rise for farms above 2.5 acres. From the point of view of net revenue, negative return was recorded for farms of <2.5 acres, while increasing trend was observed for farms above 2.5 acres. In other words, taking into account all size group of farms together, higher proportion of cost was appropriated for family labour followed by hired labour. An average paddy cultivating farmer in the area after inclusion of all costs including imputed cost is entitled to get only Rs.741 as return per acre and might feel comfortable with the deduction of all imputed costs from the revenue.

The estimated cost and revenue particulars of sugarcane cultivation for the selected sample households from the ayacut areas of Lower Bhavani Project revealed that among the costs included in the calculation of return for sugarcane cultivating farms, the share of hired labour was the highest in all farms ranging from 54.73 percent (<2.5 acres) to 67.37 percent (>7.5 acres)
followed by the seed cost. In other words, taking together all size group of farms, the proportion of seed cost to the total cost of sugarcane production was 18.60 percent. It may be due to the fact that, in the cultivation of sugarcane, seed was considered to be the important input on which the whole economics of sugarcane depends. Though sugarcane was observed to be an occupation for majority of farm families, their labour force contribution was recorded to be only 4.70 percent as against 64.13 percent recorded for hired labour. The net revenue calculated for the sugarcane cultivating farms in the area reveals that an average farmer with the total expenditure of Rs.29519/- could get Rs.17271 as net revenue per acre.

Thus, based on the estimates of the economics of crop production in Thadapalli and Lower Bhavani Project irrigated areas of the Bhavani River Project, the following observations can be accounted for policy planning suitable to these regions.

1. Among the various size group of farms cultivating paddy and sugarcane, a comparative advantage has been witnessed for farms in the size group of 5.0-7.5 acres. Therefore, optimum farm in these areas might fall only on these groups.

2. Seed cost, being a basic input recorded to be an average of 4-5 percent for paddy; it was above 15 percent for sugarcane.

3. The proportion of family labour cost was recorded to be the highest among all costs for paddy in both areas; while higher proportion of hired labour cost was registered for sugarcane in both areas.
4. The cost of chemical fertilizer was found on the rise for large farms, while higher proportion of pesticide cost was witnessed for smaller sized farms, cultivating paddy in both areas.

5. Excessive use of pesticide and some extent was observed for farms with <2.5 acres of paddy.

6. Among the category of farms cultivating paddy and sugarcane, sugarcane cultivating farmers in both the ayacuts had a comparative advantage over the farmers involved in paddy cultivation.

7. Between farms cultivating paddy and sugarcane, a comparative advantage had been witnessed for paddy to the farmers of Lower Bhavani Project while the farmers of Thadappalli had the advantage in cultivating sugarcane on a larger scale.

**TECHNICAL EFFICIENCY**

The technical efficiency of selected farms involved in crop production viz., paddy and sugarcane from the two ayacuts viz., Thadapalli and Lower Bhavani Project ayacut areas of the Bhavani River Project in Tamil Nadu was estimated separately for each crop by fitting a Frontier Production Function. For the purpose of estimation, the area under crop concerned, seed, family labour, hired labour, machine hours used, quantity of chemical fertilizer used and the cost of pesticide were included as input variables. The Maximum Likelihood Estimation method was employed to obtain the maximum possible output function separately for each crop and region.
The maximum likelihood estimates of the stochastic frontier production based on the sample farm level data pertaining to Thadappalli-ayacut indicates the fact that four input variables viz., area under crop, seed, hired labour and quantity of chemical fertilizer were registered with a priori signs and statistically significant. Though, the use of family labour, machineries and cost of pesticide have positive impact on crop output, the estimates were not statistically significant. Besides, most of the MLE estimates worked out for the input variables especially on seed, area under crop, hired labour and chemical fertilizer were higher than those obtained through OLS method, indicating the possibility of increasing the paddy yield with respect to the given inputs and technology. In other words, 77 percent of the difference between the observed and frontier output among farms was mainly due to the inefficient use of resources which are under the control of the sample farmers in the area.

The maximum likelihood estimates of the stochastic frontier based on the sample farm level data obtained from the paddy cultivating farmers of the LBP ayacut area revealed that many of the MLE estimate have expected signs and are significant, except family labour and machine hours. Besides, most of the MLE estimates derived from the farm level data applicable to the Lower Bhavani Project ayacut areas were found higher than (except hired labour) the estimates of the Thadappalli ayacut areas and are statistically significant. These differences in the estimates clearly showed that the farmers of the Lower Bhavani Project canal areas have comparative advantage over the
farmers of Thadappalli canal areas in utilizing farm resources. As such farmers of these areas are deemed to be more efficient than the farmers of the Thadappalli canal in realizing paddy output, inspite of the fact that in both areas paddy production is witnessed with the operation of diminishing returns to scale.

The technical efficiency was estimated separately by fitting a frontier production function for sugarcane based on the farm level data obtained from the selected sugarcane cultivating farmers of Thadappalli and Lower Bhavani Project ayacut areas. The input variables were included on the basis of the nature of farming system as well as their importance on sugarcane production. The coefficients of all input variables with respect to sugarcane output have registered positive signs. The elasticity value for area of land under crop was relatively high in both areas followed by hired labour which are statistically significant indicating the fact that sugarcane production is largely influenced by the fertility of land and the labour, especially the hired labour. The coefficient of chemical fertilizer is another important input variables effecting sugarcane production, whose signs were positive and statistically significant for both regions. Other input variables viz., family labour, machine hours used and pesticide components, despite their positive association with sugarcane output, do not found significant statistically. However, the sum of the regression coefficients with respect to all input variables have been worked out for the Thadappalli ayacut areas indicating the operation of increasing return to scale, while constant returns to
scale was observed for the Lower Bhavani Project ayacut farmers cultivating sugarcane.

In order to find out the extent of farm level inefficiencies witnessed for paddy and sugarcane cultivating farmers of both ayacut areas, technical efficiency scores were worked out through the maximum likelihood estimates of the frontier production function.

It is observed that the average level of technical efficiency was estimated to 80 percent for the Thadappalli canal farms, indicating the fact that the paddy output can be raised by 20 percent by following better crop management practices without having to increasing the level of application of inputs. It is also observed that 61 percent of the sample farms were operated at the efficiency levels of 70-90 percent. The mean technical efficiency for farms of <2.5 acres, 2.5-5.0, 5.0-7.5 and >7.5 acres had been worked out to 0.77, 0.80, 0.84 and 0.82 respectively, of which the farmers in the size group of 5.0-7.5 acres of paddy cultivation in the area were termed as more efficient than the other groups. This might be due to the fact that the optimum size of farm falls on these category.

In the Lower Bhavani Project canal areas, on an average 82 percent of technical efficiency is observed, and the remaining 18 % inefficiency could be raised through efficient crop management practices. Similar to the Thadappalli ayacut area, 8 percent of the paddy cultivating farmers of the Lower Bhavani Project canal areas operated below the efficiency level of 60% while 18 percent of the farmers were with the efficiency level of more
than 90%. The mean technical efficiency of farms with the size group of <2.5 acres, 2.5-5.0, 5.0-7.5 and >7.5 acres of paddy cultivation in the LBP ayacut was worked out to 0.80, 0.82, 0.86, and 0.84 respectively,

Taking together the efficiency of paddy cultivating farmers of both ayacuts, the paddy cultivating farmers of LBP ayacut areas of the Bhavani River Project would be termed as more efficient in using the resource inputs, inspite of the fact that in both areas the optimum size of farms might fall in the category of above 5 acres of paddy cultivation.

The technical efficiency estimated for different size group of sugarcane cultivating farmers ranged between 0.78 (<2.5 acres) and 0.86 (5.0-7.5 acres) with a mean of 0.82 for all farms in the Thadappalli ayacut area. It was also be a point to note that 23 percent of the farmers in the area were operating closer to the frontier output (>90 percent). Besides, above 50 percent of the sugarcane cultivating farmers in the area were operating at the efficiency levels of 70-90 percent. Among the category of farms, farms of 5.0-7.5 acres of sugarcane cultivation is deemed to be more efficient than the other farms as evidenced from its mean technical efficiency of 0.86.

The estimated technical efficiency based on the farm level data of the Lower Bhavani Project ayacut areas revealed the fact that, on an average the sugarcane cultivating farmers in the area were operating at the efficiency level of 81 percent, indicating the fact that output can be raised by 19 percent through efficient crop management practices with out having to increase the level of application of inputs. The mean level technical efficiency between
groups ranged between .79 (<2.5 acres) and 0.83 (>7.5 acres) with a mean of 0.81 for all farms. Of which, 12 percent of the farmers were operating <60 percent of their efficiency level, 16 percent were with the efficiency level of 60-70 percent, 7 percent were with the efficiency level of 70-89 percent, 33 percent were at the efficiency level of 80-90 percent and 21 percent were at the efficiency level of >90 percent. Among the various group of farms, comparative advantage had been witnessed for the farms of >7.5 acres of sugarcane cultivation and deemed to be more efficient than the other groups of farms.

Taking together these two ayacut areas, though the differences in the estimates of efficiencies are not very significant, comparative advantage had been witnessed for the Thadappalli ayacut areas.

DETERMINANTS OF TECHNICAL EFFICIENCY

Crop output is generally conditioned by the distribution of soil fertility, rainfall, incidence of disease and pests, and other agro-climatic factors. Therefore, a simple linear regression model was used to identify the factors that influence the technical efficiency of the farm households of paddy and sugarcane in the two selected ayacuts of Erode District. The efficiency scores generated by the frontier model were regressed on the variables viz., Age, Education, Farm Size and Family Size.

Education farm size and age with respect to paddy and sugarcane in both areas were positively related with the technical efficiency and most of the coefficients were statistically significant. It can be inferred that the
technical efficiency was influenced by education, as the presence of educated adult in the family adds to the efficiency in crop output. Farm size has crucial impact on technical efficiency on the ground that larger the farm size larger would be the accessibility to finance, technology, resulting to the economic use of farm resources. Family size had negative relationship with farm level technical efficiency especially on paddy. In other words, larger the family size larger would be the dependency of family labour on farms which might influence the farm level efficiency negatively. However, the impacts of family size on sugarcane production in both areas were found positive but not statistically significant between farms of the two ayacuts.

IMPLICATION OF THE STUDY

Thus, the overall results of the present study have certain policy implications because the study not only provides empirical measures of efficiency indicates applicable to farm production planning but also would help us to identify the potential of improvement in crop production across various farming systems based on efficiency. The results of the study also provide insights into the sustainable methods of productivity improvement without any additional resources. As the study revealed that education influenced technical efficiency significantly, efforts should be made to popularise both formal and informal education to farmers in the area.

SUGGESTIONS

Based on the observations derived on the study in the sample area, the following are the suggestions which are to the forwarded to the policy makers in general and the farmers in particular in the area.
1. Farmer should be provided with minimum support price for their produce to make them survival assured.

2. Steps may be taken to conserve the soil health. Soil health cards will enable farmers to participate actively in the soil fertility enhancement movement.

3. Timely availability of credit at an affordable rate of interest will help farmers to reduce distress.

4. Steps may be taken to build on the skills of farmers as agricultural entrepreneurs through links with technology, markets, society and the government.

5. A water literacy movement may be launched and regulated for sustainable use of groundwater as well as for preventing pollution.

6. Steps may be taken to cover all the farmers under crop insurance.

7. Efforts may be taken for assured remunerative marketing for agriculture produce.

8. The agricultural department officials may give training and suggestion to the farmers regarding the use of recommended dose of fertilizer and pesticide.

9. To reduce the harvesting cost of paddy and sugarcane, machinery with high technology may be used with increased numbers.

10. Fertilizer and pesticide should be supplied to the farmers with subsidies.

11. Government should take stringent action against the polluter of water and air.