TECHNICAL EFFICIENCY OF MILK PRODUCTION IN TAMIL NADU OF INDIA: FRONTIER PRODUCTION FUNCTION APPROACH

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ABSTRACT

A study was undertaken to analyse the technical efficiency of milk production in the state of Tamil Nadu. By applying multidimensional scaling method, the state of Tamil Nadu was segmented into four homogenous milk zones based on the resource endowment of the districts, favourable for dairy development. From the four zones, four districts viz., Kanchipuram, Erode, Nagappattinam and Thoothukudi were selected to represent each zone based on the factor scores obtained by these districts in each zone. A total sample size of 480 dairy farmers were selected for the present study. To estimate the level of efficiency in milk production, stochastic frontier production function was used. The farm specific technical efficiencies revealed that the distribution of most efficient elite group (Technical efficiency more than 90 per cent) of dairy farmers was the highest in Erode district (42.5 per cent) followed by Kanchipuram district (39.17 per cent) and Nagapattinam district. The mean technical efficiency was 85.5 per cent, 85.8 per cent, 82.7 per cent and 77.4 per cent respectively for Kanchipuram, Erode, Nagapattinam and Thoothukudi district indicating that on an average the sample farmers tended to realise 77.4 to 85.8 per cent of their technical abilities and the remaining per cent of their technical abilities were not realized.

Key words: Frontier production function, Milk production, Technical efficiency.

INTRODUCTION

Dairying in India has emerged as an important sub-sector, accounting for nearly two-thirds of the total livestock contribution to GNP with an encouraging growth rate of five per cent over years. Through improved breeding, feeding and management programmes, there has been marked improvement in the country’s milk production and productivity of milch animals. The dairy industry in India has taken a rapid stride during the past three decades. The production of milk has gone up more than five fold since independence, resulting in near doubling of per capita availability of milk. Dairy farming as visualized by the farmers in Tamil Nadu state is that it is part of an integrated agricultural system where dairy and agriculture complement each other. To judge whether the farmers are efficient or otherwise, estimating the technical efficiency of dairy farmers is important. To maximise the production and thereby profit, the farmer depends on his limited resources available viz., inputs, genetic potential of the animal and feed quality apart from the technical efficiency of dairy farmers. Analyzing the technical efficiency of the dairy farmers is essential before suggesting policies to augment production and thereby the profit. Keeping these facts in mind the present study was designed to analyse the technical efficiency in milk production in Tamil Nadu.

MATERIALS AND METHODS

By applying multidimensional scaling method, the state of Tamil Nadu was segmented into four homogenous milk zones based on the resource endowment of the districts favorable for dairy development. From the four zones the four districts viz., Kanchipuram, Erode, Nagappattinam and Thoothukudi were selected to represent each zone. From each district, 120 dairy farmers from 12 villages (10 farmers from each village) were selected.
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randomly. In all, a total sample size of 480 dairy farmers were selected for the present study. Information relating to various aspects of dairy farming was collected from selected farmers by survey method with a well-designed and pre-tested interview schedule. The data collected are analysed with a view to achieve the objectives of the study as follows.

Stochastic frontier production function

Stochastic frontier production function analysis was done to find out the technical efficiency of dairy farms in the study area. The frontier production function represents a maximum possible output for any given set of inputs setting a limit or frontier on the observed values of dependent variable in the sense that no observed value of output is expected to lie above the production function. Any deviation of a farm from the frontier indicates the extent of farm’s inability to produce maximum output from its given sets of inputs and hence represent the degree of technical inefficiency.

The technical efficiency in production was generally estimated by using the stochastic frontier production function. The stochastic frontier production function was independently proposed by Aigner et al. (1977) and Meeusen and Broeck (1977). The estimation of stochastic frontier production function made it possible to find out whether the deviation in technical efficiencies from the frontier output is due to firm specific factors or due to external random factors. A large number of studies are available on the use of stochastic frontiers for the measurement of technical efficiency in production (Dawson and Lingard, 1989; Kalirajan, 1990).

\[ Y_i = f(X_i, \beta) \exp(V_i - U_i) \]

The stochastic frontier model can be represented as:

Where,

- \( Y_i \) = production of \( i^{th} \) farm
- \( f(x, \beta) \) = a suitable function of the vector \( X_i \) of inputs for the \( i^{th} \) firm and \( \beta \) is the vector of unknown parameters.
- \( V_i \) = the symmetric component of the error term.
- \( U_i \) = the non-negative random variable which is under the control of the farm.

Given the density function of \( U_i \) and \( V_i \), the frontier production function can be estimated by maximum likelihood techniques.

Following Baltese and Coelli (1988), when output is measured in logarithms, the farm specific technical efficiency can be estimated as:

\[ \text{TE}_i = \exp(-U_i) \]

\( i = 1, 2, 3, \ldots, n, 0 < \text{TE}_i < 1 \)

The variance ratio \( \gamma \) explaining the total variations in output from the frontier level of output attributed to technical efficiencies can be computed as

\[ \gamma = \frac{\sigma^2_U}{\sigma^2} \]

Model specification

The stochastic frontier production function of the Cobb-Douglas type was specified for this study, and the model specified is as follows:

The model used was

\[ Y_i = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + \beta_5 \log X_5 + V_i - U_i \]

\( i = 1, 2, \ldots, n \).

\( Y_i \) = Total milk production in liters per farm per annum

- \( X_1 \) = Concentrates in Kgs.
- \( X_2 \) = Green fodder in Kgs.
- \( X_3 \) = Dry fodder in Kgs.
- \( X_4 \) = Labour in man-days
- \( X_5 \) = Health expenditure in rupees

\( \beta_0 \) = The constant term

\( \beta_i-b_5 \) = Parameters to be estimated.

\( V_i \) = A random noise variable and

\( U_i \) = Half-normal error term.

RESULTS AND DISCUSSION

Measurement of Technical efficiency in milk production

Stochastic frontier production function analysis: To estimate the level of efficiency in milk production, stochastic frontier production function was used. On the basis of the frontier, the efficiency of management practices in milk production was estimated. The parameter estimates of maximum likelihood method for the frontier production function are shown in Table 1.

The results revealed that out of the five variables used in the analysis, the frontier co-efficient for the variable concentrate was found to influence
positively the milk production and was statistically highly significant \((P<0.01)\) in the frontier function estimated for all the four districts of the study area. The variable green fodder was also found to be positively influenced the milk production and statistically significant at five per cent level \((0.01<P<0.05)\) in Erode, Kanchipuram and Thoothukudi district, while in the frontier function estimated for Kanchipuram district this variable was statistically significant at one per cent level. The dry fodder variable was found to be positive in all the districts but was found to be non-significant with all the districts except Thoothukudi district. The labour variable was negative and statistically non-significant in the sample districts except Nagapattinam district, in which this variable was found to be significant at one per cent level.

The variance ratio \((\gamma)\) for the estimated frontier functions were given in the Table 1. It could be observed from the table that the value of \(\gamma\) was 0.74, 0.61, 0.13 and 0.54 respectively for Kanchipuram, Erode, Nagapattinam and Thoothukudi district. From these values it could be inferred that the farm specific variability contributed to 74 per cent, 61 per cent, 13 per cent and 54 per cent towards the variation in milk yield among the dairy households, which means that the difference between observed and the maximum production frontier were due to difference in farmer’s level of technical efficiency by adopting different management practices. These factors were under the control of the farm and the influence of which could be reduced to enhance technical efficiency of dairy farmers in the study area.

The mean technical efficiency of sample dairy farmers in the study area is also given in Table 1. A perusal of the table revealed that the mean technical efficiency was 85.5 per cent, 85.8 per cent, 82.7 per cent and 77.4 per cent respectively for Kanchipuram, Erode, Nagapattinam and Thoothukudi district indicating that on an average the sample farmers tended to realise 77.4 to 85.8 per cent of their technical abilities and the remaining per cent of their technical abilities were not realised. Reddy (2000) and Ganeshkumar (2001) observed similar findings in their studies.

The reason for high technical efficiency could be due to standardised managerial practices, ease of comprehensive technology, availability of adequate feed inputs in the region and the use of family labour for dairy enterprise and the reasons could be vice-versa for low technical efficiency.

**Farm Specific Technical Efficiencies in milk production:** The farm specific technical efficiencies were estimated and based on the Technical efficiency the dairy farmers were classified as most efficient group (Above 90 per cent), medium efficient group (between 80 and 90 per cent), moderate efficient group (between 70 and 80 per cent) and the least efficient group (below 70 per cent). The district wise frequency distribution of farm specific technical efficiencies are presented in Table 2. From the Table 2 it could be seen that the distribution of most efficient elite group of dairy farmers was the highest in Erode district (42.5 per cent) followed by Kanchipuram district (39.17 per cent) and Nagapattinam district and this category of dairy farmers formed the least proportion of the sample dairy farmers in Thoothukudi district.

The reverse was the case with the distribution of medium efficient dairy farmers group, where the this group of farmers were higher in Thoothukudi district (30.83 per cent) followed by Nagapattinam, Erode and Kanchipuram districts. The distribution...
TABLE 2: Farm Specific Technical Efficiency in Milk production.

<table>
<thead>
<tr>
<th>Technical Efficiency</th>
<th>Kanchipuram</th>
<th>Erode</th>
<th>Nagapattinam</th>
<th>Thoothukudi</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 70</td>
<td>9(7.50)</td>
<td>8(6.67)</td>
<td>15(12.50)</td>
<td>33(27.50)</td>
<td>140(29.17)</td>
</tr>
<tr>
<td>Above 70 and d&quot; 80</td>
<td>34(28.33)</td>
<td>30(25.00)</td>
<td>30(25.00)</td>
<td>35(29.17)</td>
<td>128(26.67)</td>
</tr>
<tr>
<td>Above 80 and d&quot; 90</td>
<td>30(25.00)</td>
<td>31(25.83)</td>
<td>34(28.33)</td>
<td>37(30.83)</td>
<td>53(11.04)</td>
</tr>
<tr>
<td>Above 90</td>
<td>47(39.17)</td>
<td>51(42.50)</td>
<td>41(34.17)</td>
<td>15(12.50)</td>
<td>159(33.13)</td>
</tr>
<tr>
<td>Total</td>
<td>120(100.00)</td>
<td>120(100.00)</td>
<td>120(100.00)</td>
<td>120(100.00)</td>
<td>480(100.00)</td>
</tr>
</tbody>
</table>

(Figures in parentheses indicate percentage to total)

was more or less homogenous among the sample districts for moderate efficient group in the study area and ranged from 25 per cent in Erode and Nagapattinam district to 28.33 per cent and 29.17 per cent in Kanchipuram and Thoothukudi districts respectively.

Higher proportion of least efficient sample dairy farmers were distributed in Thoothukudi district (27.5 per cent), in the other sample district the distribution this group was lesser and was the least in Erode district (6.67 per cent).

Thus the farm specific technical efficiency revealed that the distribution of highly efficient farmers (Technical efficiency above 90 per cent) were the highest in Erode district and the lowest in Thoothukudi district. This result warrants the need to educate the dairy farmers in the least efficient category of study area to follow the managerial practices followed by the leading edge farmers through improved extension facilities and training programmes.

CONCLUSION

From the study on estimating the level of efficiency in milk production in Tamil Nadu using stochastic frontier production function, it could be concluded that that the farm specific variability contributed to 74 per cent, 61 per cent, 13 per cent and 54 per cent towards the variation in milk yield among the dairy households. The farm specific technical efficiencies revealed that the distribution of most efficient elite group (Technical efficiency more than 90 per cent) of dairy farmers was the highest in Erode district (42.5 per cent) followed by Kanchipuram district (39.17 per cent) and Nagapattinam district. The mean technical efficiency of Kanchipuram, Erode, Nagapattinam and Thoothukudi districts indicating that on an average the sample farmers tended to realise 77.4 to 85.8 per cent of their technical abilities and the remaining per cent of their technical abilities were not realized. The reason for this range of technical efficiency could be due to the difference in managerial practices, ease of comprehensive technology, availability of adequate feed inputs in the region and the use of family labour for dairy enterprise.

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