ASSESSING THE PRODUCTIVITY OF RESOURCES IN MILK PRODUCTION IN TAMIL NADU- AN ECONOMETRIC ANALYSIS

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ABSTRACT

A study was under taken to analyse the productivity of resources in milk production in the state of Tamil Nadu. From the four sample districts (Kanchipuram, Erode, Nagappattinam and Thoothukudi), 120 dairy farmers from 12 villages (10 farmers from each village) were selected by simple random sampling technique. In all, a total sample size of 480 dairy farmers was selected for the study. Information relating to various aspects of dairy farming was collected from the selected farmers by survey method with a well-designed and pre-tested interview schedule. The data collected were tabulated and analysed with a view to achieve the objectives of the study. The results of the Cobb-Douglas milk production functions showed that the co-efficients of all the resources viz., concentrate, green fodder, dry fodder and veterinary charges except labour were positive for all the function, while the labour variable had a negative sign for all the functions. The efficiency of allocation of the resources involved in milk production was studied by comparing the MVP (Marginal value product) with the MFC (Marginal Factor Cost) of each factor of production. The MVP-MFC ratio was more than unity for concentrate (1.59), dry fodder (1.96) and veterinary care (37.24), indicating that these resources were under utilized, and there was scope for enhancing the use of these resources in the study area. The results also showed that the ratio was less than unity for green fodder (0.93). The resource wise results indicated that the resource concentrate was more than unity and this resource was under utilized in all the four districts. The variable veterinary care showed a higher MVP-MFC ratio for all the four district which means that this resource was under utilized in the study area.

Key words: Milk production, Resources, Productivity.

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. Tamil Nadu, the southernmost state of India is one of the top ten milk producing states in the country with an annual milk production of 5.78 million tonnes in the year 2009-10. Dairy farming as visualized by the farmers in Tamil Nadu state is as part of an integrated agricultural system where dairy and agriculture complement each other. To judge whether the farmers are efficiently utilizing the resources, analyzing the resource use efficiency is essential. 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 resource use efficiency of the dairy farmers is essential before suggesting some policy implications to augment production and thereby the profit. Keeping these facts in mind the present study was designed to analyse the productivity of resources in milk production in Tamil Nadu.

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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 randomly. In all, a total sample size of 480 dairy farmers was 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 were tabulated and analysed with a view to achieve the objectives of the study.

Assessing the productivity of resources in milk production: To study the productivity of resources in milk production, a modified Cobb-Douglas production function was fitted separately for each district and overall category. This was done with a view to determine the extent to which the important factors that influenced the milk production in the study area have been quantified and explained the variability in milk production. This also helps to determine whether the factors were used optimally in the milk production or not (Reddy, 2000).

The general form of function is

\[ Y = \sum_{i=1}^{a} X_i^{b_i} e^u \]

where,
- \( a \) = constant
- \( X \) = is a variable source of measure
- \( Y \) = is output
- \( b \) = estimates the extent of relationship between \( X \) and \( Y \), when \( 'X' \), \( 'Y' \) are at different magnitudes. The ‘\( b \)' co-efficient is also the elasticity of production. The equation is estimated in log-linear form by the method of ordinary least squares.

For the present study, the Cobb-Douglas type production function was specified as follows

\[ Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} e^u \]

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The general form of function is

\[ Y = \sum_{i=1}^{a} X_i^{b_i} e^u \]

where,
- \( Y \) = Total milk production in litres per farm per annum
- \( a \) = Constant term, the efficiency parameter
- \( X_i \) = Concentrates in Kgs.
- \( X_2 \) = Green fodder in Kgs.
- \( X_3 \) = Dry fodder in Kgs.
- \( X_4 \) = Labour in man-days
- \( X_5 \) = Veterinary Health Care expenditure in rupees
- \( b_i \) = regression co-efficient
- \( e \) = exponent and \( u \) = disturbance term

The function was converted into linear form by making log transformations of all the variables.

\[ Y_L = A + b_1 Z_1 + b_2 Z_2 + b_3 Z_3 + b_4 Z_4 + b_5 Z_5 \]

where,
- \( Y_L \) = log \( Y \)
- \( A \) = log \( a \) and \( Z_i = \log X_i \) (i = 1, .... 5)

Allocative efficiency of resources used in milk production: Given the technology, allocative efficiency exists when resources are allocated within the farm according to market prices and it implies the proper level of input use in production.

The marginal value products (MVPs) were calculated using the per farm production function estimates at the geometric mean levels of total output and the respective mean input levels by using the following formula:

\[ M \ V \ P = b_i \frac{Y}{P_Y} \frac{X_i}{X} \]

where,
- \( Y^- \) = geometric mean of total output
- \( X_i^- \) = geometric mean of the \( 'i'^{th} \) independent input
- \( b_i \) = the regression coefficient of the \( 'i'^{th} \) independent input
- \( P_Y \) = price per unit of output

Allocative efficiency is measured by comparing the computed marginal value product (MVP) with the marginal factor cost (MFC) or opportunity cost of the input. (Rajendran and Prabaharan, 1989) Production is said to be efficiently organised when MVP is equal to MFC.
If the ratio of MVP to MFC is equal to one, the resource is said to be optimally used. If more than one, it means the resource was underutilized. If it is less than one, the resource is said to be overutilized.

**RESULTS AND DISCUSSION**

The results of the estimated milk production functions are given in Table 1. From perusal of the table it could be noted that the co-efficient of multiple determination (Adjusted R²) was 0.741 for the pooled overall function indicating that 74.1 per cent of the variation in milk production was explained by the five resources used in milk production in the study area. Similarly the Adjusted R² value was 0.974, 0.906, 0.815 and 0.626 for Kanchipuram, Erode, Nagapattinam and Thoothukudi districts respectively, which indicated the explanatory ability of the milk production function fitted for the respective district as 97.4 per cent, 90.6 per cent, 81.5 per cent and 62.6 per cent.

A perusal of the value of regression co-efficients of the estimated functions showed that the co-efficients of all the resources except labour were positive for all the function, while the labour variable had a negative sign for all the functions. Further labour resource was statistically non-significant in all the functions except in Nagapattinam district, where this variable was significant at 5 per cent level (0.05>P>0.01) indicating the overuse of labour resource in dairy farms of Nagapattinam district.

In the pooled overall milk production function, the resources concentrate, green fodder, dry fodder and veterinary care were positively and significantly influencing the milk production. Similar trend was observed in the milk production function fitted for Thoothukudi district. In Kanchipuram district and Nagapattinam district, the resources, concentrate, green fodder and veterinary care were significantly contributing to milk production. In Erode district, only the resources, concentrate and veterinary care had a significant contribution to milk production. A strong causal effect (output elasticity of 0.815) was noted between the concentrate and milk production. Similar findings were reported by Sharma and Singh (1993) and Ahuja et al.(1999) in their study.

The value of regression co-efficient for concentrate in the pooled overall function depict that one per cent increase in concentrate use would increase the milk production by 0.309 per cent ceteris paribus and 0.337 per cent, 0.815 per cent, 0.172 per cent and 0.436 per cent in Kanchipuram, Erode, Nagapattinam and Thoothukudi districts respectively ceteris paribus.

The output elasticity for green fodder in the pooled overall function revealed that one per cent increase in green fodder use would increase the milk production by 0.14 per cent ceteris paribus. Whereas in Kanchipuram, Nagapattinam and Thoothukudi district this elevation could be to the tune of 0.573

<table>
<thead>
<tr>
<th>Resources</th>
<th>Kanchipuram</th>
<th>Erode</th>
<th>Nagapattinam</th>
<th>Thoothukudi</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrate</td>
<td>0.337 **</td>
<td>0.815 **</td>
<td>0.172 **</td>
<td>0.436 **</td>
<td>0.309 **</td>
</tr>
<tr>
<td>(X1)</td>
<td>(0.041)</td>
<td>(0.044)</td>
<td>(0.022)</td>
<td>(0.019)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Green fodder</td>
<td>0.573 **</td>
<td>0.02</td>
<td>0.125 *</td>
<td>0.123 *</td>
<td>0.14 **</td>
</tr>
<tr>
<td>(X2)</td>
<td>(0.054)</td>
<td>(0.014)</td>
<td>(0.064)</td>
<td>(0.028)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Dry fodder</td>
<td>0.036</td>
<td>0.026</td>
<td>0.016</td>
<td>0.331 **</td>
<td>0.187 **</td>
</tr>
<tr>
<td>(X3)</td>
<td>(0.031)</td>
<td>(0.068)</td>
<td>(0.071)</td>
<td>(0.058)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>Labour</td>
<td>-0.019</td>
<td>-0.059</td>
<td>-0.084 *</td>
<td>-0.081</td>
<td>-0.049</td>
</tr>
<tr>
<td>(X4)</td>
<td>(0.025)</td>
<td>(0.018)</td>
<td>(0.021)</td>
<td>(0.029)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Vet.charges</td>
<td>0.087 *</td>
<td>0.168 **</td>
<td>0.696 **</td>
<td>0.289 **</td>
<td>0.469 **</td>
</tr>
<tr>
<td>(X5)</td>
<td>(0.042)</td>
<td>(0.070)</td>
<td>(0.066)</td>
<td>(0.049)</td>
<td>(0.031)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.189</td>
<td>0.701</td>
<td>1.910 **</td>
<td>2.852 **</td>
<td>1.871 **</td>
</tr>
<tr>
<td>(X6)</td>
<td>(0.246)</td>
<td>(0.479)</td>
<td>(0.551)</td>
<td>(0.536)</td>
<td>(0.312)</td>
</tr>
<tr>
<td>R²</td>
<td>0.975</td>
<td>0.910</td>
<td>0.823</td>
<td>0.641</td>
<td>0.743</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.974</td>
<td>0.906</td>
<td>0.815</td>
<td>0.626</td>
<td>0.741</td>
</tr>
<tr>
<td>F-statistics</td>
<td>876.128 **</td>
<td>229.547 **</td>
<td>105.675 **</td>
<td>40.764 **</td>
<td>274.424 **</td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>480</td>
</tr>
</tbody>
</table>

(Figures in parentheses indicate standard errors of regression co-efficient)  
* Significant at five per cent level. ** Significant at one per cent level.)
per cent, 0.125 per cent and 0.123 percent respectively ceteris paribus.

The estimated co-efficient for dry fodder use in milk production for the pooled overall function was 0.187, indicating that one per cent in dry fodder use had corresponding 0.187 per cent increase in milk production ceteris paribus, the respective increase was 0.331 per cent for Thoothukudi district.

The output elasticity for veterinary care in milk production of the study area indicated that one per cent raise in spending on veterinary care would enhance the milk production by 0.469 per cent ceteris paribus. The relevant enhancement was highest in Nagapattinam district (0.696 per cent) followed by Thoothukudi district (0.289 per cent), Erode district (0.168 per cent) and it was the least in Kanchipuram district (0.089).

Thus the analysis of factors affecting milk production revealed that the resource feed concentrate and veterinary care were the important factors in milk production, since only these two variables have significantly contributed to the milk production function fitted for all the sample districts as well as in the overall pooled function. This result reiterated the importance of concentrate and veterinary care in milk production.

**Allocative efficiency of resources used in milk production:** The efficiency of allocation of the resources involved in milk production was studied by comparing the MVP (Marginal value product) with the MFC (Marginal Factor Cost) of each factor of production. Based on the output elasticities estimated for the resources used in estimated milk production function, MVP of the respective resources were arrived at. The marginal factor cost of concentrate, green fodder and dry fodder were the average price per unit paid by the farmer. The marginal factor cost of labour was the average price paid by the farmer as wage rate per labour per manday. The marginal factor cost of health expenditure was rupee one, since it was used in monetary values in the analysis. The allocative efficiency of resources was measured by calculating the MVP-MFC ratio.

The results of the allocative efficiency of resources in milk production are given in Tables 2, 3, 4, 5 and 6 respectively for Overall, Kanchipuram, Erode, Nagapattinam and Thoothukudi.

Table 2. shows the allocative efficiency of resources in milk production for overall pooled data. It could be observed from the table that the MVP-MFC ratio was more than unity for concentrate (1.59), dry fodder (1.96) and veterinary care (37.24), indicating that these resources were under utilized, and there was scope for enhancing the use of these resources the study area. The results also showed that the ratio was less than unity for green fodder (0.93). Although as per the usual interpretation it could be inferred that this resource was over utilized in the study area, the ratio was very close to unity, indicating the nearly optimum utilization or lesser degree of over utilization of this resource.
TABLE 4: Allocative efficiency of resources in milk production in Erode District.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Geometric mean</th>
<th>Regression Co-efficient</th>
<th>MVP(Rs.)</th>
<th>MFC(Rs.)</th>
<th>MVP-MFC Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrate</td>
<td>1237.31</td>
<td>0.172</td>
<td>8.67048</td>
<td>7</td>
<td>1.23864</td>
</tr>
<tr>
<td>Green fodder</td>
<td>4623.83</td>
<td>0.125</td>
<td>1.68617</td>
<td>2</td>
<td>0.84309</td>
</tr>
<tr>
<td>Dry fodder</td>
<td>5352.92</td>
<td>0.016</td>
<td>0.18643</td>
<td>1</td>
<td>0.18643</td>
</tr>
<tr>
<td>Labour</td>
<td>460.05</td>
<td>-0.084</td>
<td>-11.389</td>
<td>60</td>
<td>-0.1898</td>
</tr>
<tr>
<td>Vet.charges</td>
<td>720.333</td>
<td>0.696</td>
<td>60.2656</td>
<td>1</td>
<td>60.2656</td>
</tr>
</tbody>
</table>

Further the results revealed that every additional one rupee spent on concentrate, dry fodder and veterinary care yielded an additional income of Rs.1.59, Rs.1.96 and Rs.37.24 respectively. While the same yielded an additional income of Rs. 0.93 for green fodder. This result is contrary to the usual assumption that additional one rupee spent on green fodder yields an additional income of more than one rupee and only the dry fodder use would show a reduced marginal return. While this situation was witnessed only for the pooled overall data, in Kanchipuram and Thoothukudi district additional rupee spent on green fodder utilization resulted in additional income of more than unity.

The resource wise results demonstrated that the resource concentrate was more than unity and this resource was under utilized in all the four districts. Further every additional one rupee invested on this resource yielded an additional income of Rs. 1.59, Rs.4.37, Rs.1.23 and Rs.1.91 in Kanchipuram, Erode, Nagapattinam and Thoothukudi district. The variable green fodder was under utilized in Kanchipuram and Thoothukudi districts, while this resource was overused in Erode and Nagapattinam district. The dry fodder utilization was more than optimum only in Thoothukudi district. The variable veterinary care showed a higher MVP-MFC ratio for all the four district and this resource was under utilized in the study area. And every one rupee invested on this variable had an additional income of Rs.7.11, Rs.10.38, Rs. 60.26 and Rs.48.18 in Kanchipuram, Erode, Nagapattinam and Thoothukudi districts respectively, which proves the advantage of proper health care like deworming, vaccination etc.

CONCLUSION
An attempt was made in this study to estimate the productivity of resources and to analyse whether the resources used in milk production in the study area were optimally allocated or not. In order to accomplish this task, a modified Cobb-Douglas production function was fitted for the five resources viz., concentrate, green fodder, dry fodder, labour and veterinary expenses, used in milk production in the study area for Kanchipuram, Erode, Nagapattinam and Thoothukudi district separately and in combination for the pooled data in the study area. The results of the Cobb-Douglas milk production functions showed that the co-
efficients of all the resources except labour were positive for all the function, while the labour variable had a negative sign for all the functions. The efficiency of allocation of the resources involved in milk production was studied by comparing the MVP (Marginal value product) with the MFC (Marginal Factor Cost) of each factor of production. The MVP-MFC ratio was more than unity for concentrate (1.59), dry fodder (1.96) and veterinary care (37.24), indicating that these resources were under utilized, and there was scope for enhancing the use of these resources in the study area. The results also showed that the ratio was less than unity for green fodder (0.93). The resource wise results demonstrated that the resource concentrate was more than unity and this resource was under utilized in all the four districts. The variable veterinary care showed a higher MVP-MFC ratio for all the four district and this resource was under utilized in the study area.

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