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RESEARCH ARTICLE

PRODUCTIVE EFFICIENCY OF MILK PRODUCTION BETWEEN COWS AND BUFFALOES

[1]Dr. S. Amutha Rani and [2,*]Dr. M. Gurupandi

[1]Department of Commerce, Sri Kaliswari College, Sivakasi-626130.Virudhunagar, Tamilnadu, India
[2]Department of International Business and Commerce, Alagappa University, Karaikudi-626130, Sivaganga, Tamilnadu, India

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ABSTRACT

To maximize the production and thereby profit, the producers depends on his limited resources available viz., inputs, genetic potential of the animal and feed quality. An attempt is made to find the input variables which influence the gross return of milk production and thereby the resource productivity with respect to cow, buffalo and pooled category of milk producers selected. The structural differences are to be examined between cow and buffalo. Further, an attempt is made to examine the resource-use efficiency by equating the Marginal Value Productivity (MVP) of each resource input to its Marginal Factor Cost (MFC). This determines whether the factors are used optimally in the production of milk.

INTRODUCTION

India has attained and retains the first rank in milk production in the world. The first five countries in the world producing maximum milk are India, USA, Russia, Germany and China. Today, India is 'The Oyster' of the global dairy industry. It offers opportunities galore to entrepreneurs worldwide, who wish to capitalize on one of the world's largest and fastest growing markets for milk and milk products. The performance of the Indian dairy sector during the past three decades has been very impressive. Milk production grew at an average annual rate of 4.57 percent during the 1970s, 5.68 percent during the 1980s, 4.21 per cent during the 1990s and 4 per cent during the year 2000 and it is expected to reach 170 million tons in 2020. Tamil Nadu is an agricultural state and a majority of the farmers own cattle. It is one of the frontline states of India in milk production. It occupies the 4th place in milk procurement by Dairy Co-operatives and it is 22.30 lakhs liters per day.

In many states, this has been done by establishing and encouraging the formation of milk producer's co-operatives. These institutional bodies operate in the rural areas to collect and handle milk supply from the producers and distribute the milk to the city dwellers and consumers.

Corresponding author: Dr. M. Gurupandi,
Department of International Business and Commerce, Alagappa University, Karaikudi-630004, Sivagangai, Tamilnadu, India.

Objective of the study

The objectives of this paper includes the following

1. To estimate the marginal value productivities of various inputs in order to suggest the possibilities of their reallocation for further increase in milk production.
2. To measure the returns to scale parameter in milk production and
3. To examine the structural difference in the yield of milk production between cow and buffalo.

Sample design and collection of data

Among the Milk Production District in Tamil Nadu, Virudhunagar District has a history of its own. In Virudhunagar District, Srivilliputhur Taluk, is very famous for 'Palgova'. It has the Anand Cooperative Society and two chilling plants. More than 3,20,0000 litres of milk was traded with value of nearly 4.50 crores per year in this district through cooperative milk societies. This study is based on primary data. First hand data were collected from the field directly from the respondents by using interview schedules. The sample covers 240 milk producers. The data were collected from the respondents by using snow ball sampling. Among these 240 milk producers, 211 milk producers have their own milch cows and 17 milk producers have own milch buffaloes and 12 have own both milch cows and milch buffaloes. The primary data were collected during the months of October 2012 to May 2013 of the calendar Year.

Tools of analysis

The Cobb-Douglas Production Function Analysis

The production function is purely a technical relationship which connects factor inputs and outputs. It specifies that the maximum outputs can be obtained either with a given input combination or the minimum quantity of inputs necessary for a given output. The Cobb-Douglas production function has been fitted in order to determine the efficiency of each variable in the production of milk. In the linear regression model, one dependent and seven independent variables have been included in the form given below.

$\ln Y = \beta_0 + \beta_1 \ln X_{1+} \beta_2 \ln X_{2+} \beta_3 \ln X_{3+} \beta_4 \ln X_{4+} \beta_5 \ln X_{5+} \beta_6 \ln X_{6+} \beta_7 \ln X_{7+} U$ ……..

Where β_0 is intercept

Y = Value of Milk yield per animal per day during the lactation period in rupees.
X_1 = Value of green fodder fed per animal per day during the lactation period in rupees
X_2 = Value of dry fodder fed per animal per day during the lactation period in rupees
X_3 = Value of concentrate fed per animal per day during the lactation period in rupees
X_4 = Value of maintenance cost per animal per day during the lactation period in rupees
X_5 = Value of miscellaneous expenses per animal per day during the lactation period in rupees
X_6= Value of labour cost per animal per day during the lactation period in rupees
X_7 = Value of capital per animal per day during the lactation period in rupees

U refers to disturbance term

$\beta_0, \beta_1, \beta_2, \beta_3$..... β_7 are the Parameters to be estimated

The structural difference between cow and buffalo in tested by using the chow test F-test

$$F = \frac{\sum e^2 - (\sum e_1^{\,2} + \sum e_2^{\,2})/k}{(\sum e_1^{\,2} + \sum e_2^{\,2})/n_1 + n_2 - 2k}$$

Where

$\sum e^2$ = Unexplained Sum of Square for Pooled Category
$\sum e_1^2$= Unexplained Sum of Square for Cows
$\sum e_2^2$= Unexplained Sum of Square for Buffaloes
n_1= Number of Observation for Cows
n_2 = Number of Observation for Buffaloes
k= Number of Parameters including the Intercept term.

The Marginal Value Productivity and Resource-Use Efficiency

The Marginal Value Productivity (MVP) of a factor is defined as the change in output (gross returns) resulting from a change of the factor, keeping all other factors constant. Marginal value products of the resource inputs are measured from the following formula

$MVPx_1$ - Greed Fodder = $\beta_1 \frac{\overline{Y}}{\overline{X_1}}$

$MVPx_2$ - Dry Fodder = $\beta_2 \frac{\overline{Y}}{\overline{X_2}}$

$MVPx_3$ - Concentrates = $\beta_3 \frac{\overline{Y}}{\overline{X_3}}$

$MVPx_4$ - Maintenance Cost = $\beta_4 \frac{\overline{Y}}{\overline{X_4}}$

$MVPx_5$ - Miscellaneous Expenditure = $\beta_5 \frac{\overline{Y}}{\overline{X_5}}$

$MVPx_6$ - Labour Cost = $\beta_6 \frac{\overline{Y}}{\overline{X_6}}$

$MVPx_1$ - Capital Flow = $\beta_7 \frac{\overline{Y}}{\overline{X_7}}$

RESULTS AND DISCUSSION

Productivity

The estimated results of the regression model for cows, buffaloes and the pooled category are presented in Table 1

Table 1. Estimated Regression Result of Milk Production

Variables	Parameters Estimates		
	Cow	Buffalo	Pooled
Intercept	2.7146	2.4389	2.8817
X_1	0.2784*(3.7075)	0.2051*(2.8224)	0.12663*(4.4437)
X_2	0.0014(0.1879)	0.0780(0.2469)	0.3073*(0.6696)
X_3	0.0512(0.1848)	0.0109(0.0815)	0.0079(0.7863)
X_4	0.0539(0.3658)	0.1519*(1.8790)	0.03743(0.8488)
X_5	0.1718*(6.9825)	0.040688(0.4366)	0.18553*(8.034)
X_6	0.4606*(8.4481)	0.43112*(3.8796)	0.4872*(13.621)
X_7	0.2655*(2.6289)	0.2641*(2.2640)	0.1548*(4.2522)
R^2	0.9781	0.8169	0.9499
F-Value	12.96	5.73	59.11
Residual Sum of Square$\sum e^2$	0.1557	0.1182	0.4461

*The co-efficient are statistically significant at 5 % level. Figures in brackets are the t-values
Source: Compiled from primary data

It is evident from the above Table 1 that the explanatory variables included in the model for the cow, buffalo and the pooled category have shown greater variation in gross returns of milk. In the case of cows, the co-efficient of multiple determinations (R^2) is 0.9781 indicating 97.81 per cent variation in gross returns associated with the variables included in the model. The regression co-efficient of the variables namely green fodder, miscellaneous expenses, labour cost and value of capital are significant at the 5 per cent level which means that for one per cent increase in the investment of these resources the gross return could be increased by 0.2784,0.1718, 0.4606, 0.2655 per cent respectively. In the case of the buffalo,

all the seven explanatory variables are jointly responsible for 81.69 per cent of gross return of milk. The co-efficient of green fodder fed, maintenance cost, labour cost and value of capital are significant at the 5 per cent level which means that for one per cent increase in the investment of these resources the gross return could be increased by 0.2051, 0.1519, 0.43112 and 0.2641.

In the case of the pooled category, all variables are jointly responsible for 94.99 per cent of the gross return of milk. The co-efficient of the green fodder fed, dry fodder fed, miscellaneous expenses, labour cost and value of capital are significant at the 5 per cent level which means that for one per cent increase in the investment of these resources gross return could be increased by 0.12663, 0.3073, 0.18553, 0.4872 and 0.1548. The regression co-efficient of all the inputs are positive in all the equations fitted. This indicates that there is great scope of increasing the production of milk by increasing the use of these inputs. It is noted that among the seven inputs, items such as green fodder fed, dry fodder fed, miscellaneous expenses, labour cost and value of capital are more influencing variables in milk production. The cost of concentrate fed has been found minimum in all cases. That is, it is uniformly a poor influence on milk production.

Return to Scale

Estimated Return to Scale Parameter in Milk Production is presented in the following table.

Table 2. Return to Scale

S.No	Category	Return to Scale Parameter
1	Cow	1.28
2	Buffalo	1.18
3	Pooled	1.31

Source: Compiled from primary data

The returns to scale have been estimated from the estimated co-efficient at the production functions. The magnitude of returns to scale indicates the per cent increase in milk production when all the inputs are increased simultaneously by one per cent. In the case of cow, buffalo and pooled, the returns to scale show that the production of milk is expected to increase by 1.28, 1.18 and 1.31 per cent respectively when all the inputs are simultaneously increased by one per cent. The scope for increasing of milk production can be increased by increasing the input factors.

Structural Difference in the Yield of Milk Production between Cow and Buffalo

Chow's test has been applied in order to examine whether structural relations of cow and buffalo are different from each other regarding the yield of milk.

H_o: There is no structural difference exists between cow and buffalo regarding the yield of milk

Table 3. Test for Structural Differences between Cow and Buffalo

$\sum e^2$	$\sum e_1^2$	$\sum e_2^2$	F*	F (210) at 1% Level	Inference
0.4461	0.1557	0.1182	16.499	2.5113	Structural difference exists between cow and buffalo regarding the yield of milk

Source: Compiled from primary data

It is evident from Table 3 that the computed F – value (F*) is greater than the table value of F at the one per cent level with (210) degree of freedom. Hence, it can be concluded that there is structural difference between the production of cow and buffalo.

Resource-Use Efficiency

Resource-use efficiency is studied by estimating the ratio of the Marginal Value Product (MVP) of each resource input to the price of that resource namely Marginal Factor Cost (MFC). Equity of MVP and Factor Cost (MVP / MFC = 1) indicate the optimum resource-use efficiency of a particular input. Inequality of MVP and factor cost (MVP / MFC ≠1) indicates the degree of resource-use inefficiency. Where the ratio (MVP / MFC>1) is more than one and the regression co-efficient is significant, the resources input is said to be under-utilized. Similarly, where the coefficients are negative and significant, the resource input is said to be over-utilized.

Table 4. Marginal Value Productivity (MVP) and Resource-use Efficiency of Input in Milk Production for Cow

Variables	Geometric Mean	Elasticity of Output	MVP	MFC	Ratio of MVP to MFC
X_1	33.18	0.2784*	1.579	1.0	1.579
X_2	12.63	0.0014	0.021	1.0	0.021
X_3	9.94	0.0512	0.969	1.0	0.969
X_4	18.76	0.0539	0.541	1.0	0.541
X_5	6.97	0.1718*	4.642	1.0	4.642
X_6	25.91	0.4606*	3.354	1.0	3.354
X_7	17.02	0.2655*	2.936	1.0	2.936

Source: Compiled from primary data, *Indicates significant at 5 % level.

Table 5. Marginal Value Productivity (MVP) and Resource-use Efficiency of Input in Milk Production for Buffalos

Variables	Geometric Mean	Elasticity of Output	MVP	MFC	Ratio of MVP to MFC
X_1	30.62	0.2051*	3.89	1.0	3.89
X_2	9.73	0.0780	0.471	1.0	0.471
X_3	2.01	0.0109	1.002	1.0	1.002
X_4	18.87	0.1519*	1.487	1.0	1.487
X_5	6.99	0.0407	1.076	1.0	1.076
X_6	29.18	0.43112*	2.730	1.0	2.730
X_7	14.38	0.2641*	3.394	1.0	3.394

Source: Compiled from primary data, *Indicates significant at 5 % level.

The Marginal Value Productivity (MVP) has been found greater than unity for green fodder fed, miscellaneous expenses, labour cost and value of capital in the case of cows. This indicates that the added returns at this level are higher than the additional cost incurred for the additional unit of these inputs. The MVPs of dry fodder, concentrates and maintenance cost have been registered as lower. Therefore, the withdrawal of one unit of these inputs could improve the gross returns. It is

suggested that the employment of theses resource should be reduced till the ratio become unity. In other words, the part of dry fodder, concentrates and maintenance cost should be transferred to green fodder fed, miscellaneous expenses, labour cost and value of capital in order to attain the maximum level of output.

The Marginal Value Productivity (MVP) has been found greater than unity for green fodder, concentrates, maintenance cost, miscellaneous expenses, labour cost and value of capital in the case of buffalo. This indicates that the added returns at this level are higher than the additional cost incurred for the additional units of these inputs. The MVPs of dry fodder have been registered as lower. This indicates that there is over utilization of this input. Therefore, the withdrawal of one unit of these inputs could improve the gross returns. It is suggested that the employment of these resources should be reduced till the ratio becomes unity. In other words, the part of green fodder should be transferred to concentrates, maintenance cost, miscellaneous expenses, labour cost and value of capital in order to attain the maximum level of output.

Conclusion

The Cobb Douglas production function used to measure the return of given inputs. All the regression coefficients have been found positive and indicate that the producer can increase their milk production by increasing their inputs. As per the collected data the magnitude of returns to scale indicates the per cent increase in milk production when all the inputs are increased simultaneously by one per cent. In the case of cow's, buffalo's and pooled, the returns to scale shows that the production of milk is expected to increase by 1.28, 1.18 and 1.31 per cent respectively when all the inputs are simultaneously increased by one per cent. There is a structural difference between the cow's and buffalo's milk production. The results of this study would help to provide a guideline for the policy makers in formulating feasible and viable animal husbandry policy.

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