



Milk Production Function and Resource use Efficiency in Rajasthan

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ABSTRACT

The study was undertaken in Rajasthan with the objective to examine the input-output relationships and assess the resource use efficiency in milk production. The study covered 60 dairy households. The results of Cobb-Douglas production function revealed that concentrate had positive and significant influence on returns from buffalo, crossbred cow and local cow milk. Green fodder and labour were also significantly influenced the returns from buffalo, crossbred and local cow. The results of resource use efficiency and marginal value productivity of inputs indicated that inputs were not optimally utilized by dairy households. The green fodder, dry fodder, concentrate and labour in buffalo, concentrate and labour crossbred cow milk production and green fodder in local cow milk production were found to be over utilized in study area resulting higher per litre cost of milk production on these species.

Keywords: Green fodder, Dry fodder, Concentrate, Milk production function, Resource use efficiency

Livestock in Rajasthan state plays an important role determining the rural economy. Rajasthan is the second largest milk producing state in the country. Rajasthan has a share of 12.61 per cent of total milk production of the country during 2016-17. The per capita per day availability of milk was 785 grams was more than as compared to the national average of 355 grams (NDDB, 2016-2017). Buffaloes and cows are the primary sources of milk production.

The milk production is a complex biological phenomenon controlled by a number of factors. The milk conversion process is controlled by genetic and non-genetic factors. The important genetic agents are types of breed and ability for milk secretion by individual animals. The non-genetic factors influencing the milk production are types, quantity and quality of feeds and fodders fed, order of lactation, stage of lactation, herd size, labour use, climatic conditions etc. It is important to know that which factors have most impact on returns of milk production. Animal Husbandry Department of state has been making concerted efforts to increase animal productivity through several initiatives in

rural areas. The type of animal reared for milk production may be determined by the resources owned by the dairy farmers. Many a times, the milk producers are not fully aware of the productivity of various resources that go in the process of milk production. The scarce resources available with the farmers force them to use these resources optimally in order to get optimum returns from milk production. Different species of animals consumed different inputs like green fodder, dry fodder, concentrate, labour, etc. in different quantities, which directly or indirectly affect the milk production. It is important to know whether the resources owned by milk producers are under-utilised or over-utilised for milk production. Therefore, the knowledge of best use of scarce resources for milk production is essential for making dairy farming a profitable enterprise. Therefore, the present investigation was carried out in Rajasthan and an attempt has been made

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to study the input-output relationship and to know resource use efficiency in milk production.

MATERIALS AND METHODS

Study area and Sampling

The study pertains to the state of Rajasthan. The Jaipur and Alwar districts were selected purposively from Rajasthan on the basis of highest livestock population. These two districts contribute approximately 11 per cent to total livestock population of the state. These two districts shared about 24.17 per cent of the registered Dairy Cooperative Societies in the year 2016-17. From each selected district, two tehsils were selected randomly. From each tehsil, one village was selected randomly. Thus, Amar and Mozamabad tehsils from Jaipur district and Kishangarhbas and Mandawar tehsils from Alwar district were selected randomly. The village Sirsali, Mokhampura from Jaipur district and Ghasoli and Mator from Alwar district were selected randomly. Thus, total four villages from four tehsils of two selected districts were taken in sample. The final sampling unit was dairy household. From each selected village, 15 dairy households having at least one lactating animal were selected randomly. Thus, a total of 60 dairy households were randomly selected for the present study. The study is based on primary data which were collected with the help of well structured pre-tested schedule by personal interview/enquiry method. This study was conducted during the year 2017-18.

Statistical Analysis

The multiple regression analysis was used to study the relationship between returns from milk and different factors influencing it. The specification of milk production function used in the present study is as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5)$$

Where, Y = Value of milk produced per animal per day (₹)

X_1 = Value of green fodder fed per animal per day (₹)

X_2 = Value of dry fodder fed per animal per day (₹)

X_3 = Value of concentrate fed per animal per day (₹)

X_4 = Value of labour employed per animal per day (₹)

X_5 = Value of veterinary expenditure per animal per day (₹)

Two types of functional forms tried are given as under,

$$\text{Linear } Y = a + \sum_{i=1}^5 b_i x_i + u$$

$$\text{Cobb-Douglas } Y = a \prod_{i=1}^5 x_i^{b_i} e^u \text{ or } \ln Y = \ln a + b_i \sum_{i=1}^5 \ln x_i + u$$

Where, Y = Output, X_i 's = Input variables used, $i = 1, 2, 3, 4, 5$, a = Constant term, b_i 's = Parameters to be estimated and u = Random error term assumed to follow normal distribution with zero mean and constant variance.

The choice for a specific functional form was made both on the basis of economic and statistical criteria. Finally, Cobb-Douglas function was found to be the best fit on the basis of coefficient of multiple determinations. Hence, results of the same have been used for analysis and interpretation in the study.

Ideally, output (Y) and inputs (X_i) in the above functional forms should be measured in physical units. However, in the present study, monetary values of inputs and output were preferred over their physical quantities. This has been done because quality of feeds and fodder differed a good deal from one respondent to the other and can be more appreciably reflected only in value terms.

Estimation of marginal value productivity and resource use efficiency

In the case of Cobb-Douglas function, MVP of all inputs was calculated at respective geometric mean levels of the factors used. The formula for ascertaining MVP of input i ($i = 1, \dots, n$) for the Cobb-Douglas function is given as follows:

$$MVP_i = \hat{b}_i \frac{\bar{Y}}{\bar{X}}$$

Where, Y and X are the geometric means of output Y and respective i^{th} input and \hat{b}_i is the estimated regression coefficient associated with i^{th} input.

A necessary condition is that MVP should be equal to its price for profit maximization. Mathematically, there exists resource efficiency in respect of the use of i^{th} input if $MVP_i = P_i$ Where, P_i is the unit price of i^{th} input. For examining the resource use efficiency, MVP of those inputs was worked out whose regression coefficients

were statistically significant in the estimated production function. Any deviation of MVP of i^{th} input from its unit price, are termed as resource use inefficiency. Further, student 't' test (Heady and Dhillon, 1988) was used to test the statistical significance of the difference between the MVP of i^{th} input and its unit price.

The t-test for this purpose was computed as,

$$t = \frac{MVP_i - P_i}{SE(MVP_i)}$$

Where,

$SE(MVP_i)$ = Standard error of MVP of i^{th} input

Standard errors in case of Cobb-Douglas form of production function was worked out as follows:

$$\text{Cobb-Douglas: } SE(MVP_i) = SE(\hat{b}_i) \frac{\bar{Y}}{\bar{X}}$$

Where, Y and X are the same notation as in case of MVP mentioned earlier and $SE(\hat{b}_i)$ is the standard error of estimated partial regression coefficients associated with i^{th} input.

RESULTS AND DISCUSSION

The results of estimated Cobb-Douglas production function for buffalo and cow have been presented in Table 1. A close perusal of the table revealed that the coefficient of multiple determination (R^2) for the buffalo, crossbred cow and local cow were 0.80, 0.80 and 0.63, respectively which indicated that 80, 80 and 63 per cent of total variation in returns from milk were explained by the variables included in the selected regression model.

Buffaloes

A further perusal of the Table 1 revealed that green fodder appeared to be an important variable influencing buffalo milk production. Its coefficient was positive and statistically significant ($P < 0.01$). On an average, one per cent increase in the expenditure on green fodder resulted in an increase of 0.268 per cent in returns from buffalo milk.

Expenditure on concentrate, dry fodder and labour appeared to be second, third and fourth most important

variable significantly influencing returns from buffalo milk. Regression coefficients of concentrate and dry fodder and labour were positive and statistically significant ($P < 0.05$). Regression coefficient of labour was also positive and statistically significant ($P < 0.01$). On an average, one per cent increase in the expenditure on concentrate, dry fodder and labour resulted in an increase of 0.135, 0.122 and 0.076 per cent in returns from buffalo milk, respectively.

The positive and significant impact of green fodder, dry fodder, labour and concentrate on returns from buffalo milk were in conformity with the findings of Meena *et al.* (2009) and Venketesh and Sangheeta (2011). The positive and significant impact of green fodder and concentrate on returns from buffalo milk were also observed by Sharma and Singh (1993), Rani and Gurupandi (2014). Ganeshkumar *et al.* (2000) found positive impact of green fodder and concentrate on returns from buffalo milk. Basavarajappa and Talathi (2012) and Singh *et al.* (2012) reported positive impact of green fodder, dry fodder and concentrates on milk production of buffalo. The regression coefficients of veterinary expenditure were not found to be statistically significant. The expenditure on veterinary services was, thus, found to have no impact on returns from buffalo milk.

Crossbred cows

A further perusal of the Table 1 revealed that labour appeared to be an important variable influencing crossbred cow milk production. Its coefficient was positive and statistically significant ($P < 0.05$). On an average, one per cent increase in the expenditure on labour resulted in an increase of 0.419 per cent in returns from crossbred milk.

Expenditure on green fodder and concentrate appeared to be second and third most important variable significantly influencing returns from crossbred cow milk. Regression coefficient of green fodder was positive and statistically significant ($P < 0.01$). Regression coefficient of concentrate was also positive and statistically significant ($P < 0.05$). On an average, one per cent increase in the expenditure on green fodder and concentrate resulted in an increase of 0.380 and 0.251 per cent in returns from crossbred milk, respectively. This result agree with findings of Sharma *et al.* (2014), Rangnath *et al.* (2015) and Lalrinsangpuii and Malhotra (2016) who reported the positive significant impact of concentrates in milk production of crossbred

Table 1: Estimated parameters of Cobb Douglas production function of buffalo and cow milk

Variables	Buffalo		Crossbred cow		Local cow	
	Regression Coefficients	Standard Error	Regression Coefficients	Standard Error	Regression Coefficients	Standard Error
Constant	3.319	0.991	1.066	0.466	2.480	2.061
Value of Green Fodder (X_1)	0.268**	0.045	0.380**	0.143	0.123*	0.056
Value of Dry Fodder (X_2)	0.122*	0.053	0.116	0.162	0.356	0.564
Value of Concentrate (X_3)	0.135*	0.055	0.251*	0.100	1.053**	0.373
Value of Labour (X_4)	0.076**	0.026	0.419*	0.167	-0.248	0.188
Veterinary Expenditure (X_5)	0.024	0.025	0.115	0.091	0.275	0.760
R ²	0.80		0.80		0.63	
N	165		31		21	

** Significant (P<0.01) * Significant (P<0.05).

cows. Ganeshkumar *et al.* (2000) and Basavarajappa and Talathi (2012) reported positive impact of green fodder and concentrates in milk production of crossbred cow. The regression coefficients of dry fodder and veterinary expenditure were not found to be statistically significant.

Local cows

A further perusal of the Table 1 revealed that green fodder and concentrate were appeared to be important variables influencing the returns from local cow. The regression coefficient of green fodder and concentrate were positive and statistically significant. On an average, one per cent increase in the expenditure on green fodder and concentrate resulted in an increase of 0.123 per cent and 1.053 per cent in returns from local cow milk. The positive and significant impact of concentrates on milk production of local cow was also reported by Ganeshkumar *et al.* (2000), Meena *et al.* (2009), Sharma *et al.* (2014), Rangnath *et al.* (2015) and Lalrinsangpuii and Malhotra (2016). The regression coefficients of green fodder, dry fodder, labour and veterinary expenditure was not having statistically significant impact on returns from local cow milk.

It is clear from the results of regression analysis that among the different feed inputs, green fodder, dry fodder, concentrate and labour in case of buffalo, green

fodder, labour in case of crossbred cow and green fodder and concentrate in case of local cow had positive and significant impact on returns from milk.

Marginal Value Productivity for buffalo and cow

The marginal value productivity of all the inputs was computed at their geometric mean level for buffalo and cow. The results are presented in Table 2 along with their prices. Since all the inputs were expressed in monetary terms in the production function, the acquisition cost of the inputs was taken as Re.1. The estimated marginal value productivity was, therefore, compared with unity to examine the resource use efficiency.

The marginal value productivity of green fodder, dry fodder, concentrate and labour were significantly much lower than their acquisition cost for buffalo milk. It implied that green fodder, dry fodder, concentrate and labour were over-utilized. The similar finding was also reported in Alwar district of Rajasthan in earlier study conducted by Meena *et al.* (2012).

The marginal value productivity of concentrate was significantly much lower than their acquisition cost for crossbred cow milk. It implied that concentrate was over-utilized. The marginal value productivity of green fodder and labour was found to be not statistically significant.

The marginal value productivity of green fodder was much lower than their acquisition cost for local cow milk and significant while it was much higher than their acquisition cost for local cow milk but non-significant in case of concentrate.

Table 2: Marginal Value Productivities of inputs along with their prices for buffaloes and cow's milk producers

Species/inputs	Buffalo	Crossbred cow	Local cow
Green fodder			
MVP	0.474	0.639	0.242
Price	1.00	1.00	1.00
Difference in MVP & price	-0.526**	-0.360	-0.758**
S.E. of difference	0.079	0.241	0.112
Dry fodder			
MVP	0.178	—	—
Price	1.00	—	—
Difference in MVP & price	-0.822**	—	—
S.E. of difference	0.077	—	—
Concentrate			
MVP	0.229	0.411	1.936
Price	1.00	1.00	1.00
Difference in MVP & price	-0.771**	-0.589**	0.936
S.E. of difference	0.094	0.164	0.685
Labour			
MVP	0.112	0.581	—
Price	1.00	1.00	—
Difference in MVP & price	-0.888**	-0.419	—
S.E. of difference	0.039	0.231	—

** Significant (P<0.01).

Thus, it may be concluded that green fodder, dry fodder, concentrate and labour in case of buffalo, concentrate in case of crossbred cow and green fodder in case of local cow were over-utilized which indicated excessive expenditure made on these inputs by the milk producers. Over-utilization could be due to easily and abundantly availability of these inputs in the study area. It was well known that mustard crop mainly grown in the study area which was the main ingredients in concentrate, further green fodder also grown by most of households at their fields. The wide network of dairy cooperatives in the study area is under operation. Most of the households disposed off their milk through dairy cooperatives and

dairy cooperative offered price of milk on the basis of fat and SNF percent. Thus, households were well aware about feeding of animals and give more emphasis on feeding of animals in order to increase fat per cent in milk. Over-utilization suggested that use of these inputs can be reduced in care and management of animals to make considerable improvement in net returns from animals in the study area. Thus, there is a potential to increase the net returns from milk production by judicious use of these over utilized inputs by using the optimum quantities of these inputs.

CONCLUSION

It may be concluded from the study that green fodder, dry fodder, concentrate & labour in case of buffalo, green fodder, concentrate & labour in case of crossbred cow and green fodder & concentrate in case of local cow had positive and significant influence on milk production. The green fodder and concentrate were the important determinants of milk production in all the milch species which can go a long way to increase returns from milk. The milk producers were not fully aware about the productivity of inputs that go in the process of milk production as revealed by the results of marginal value productivity and resource use efficiency. The use of various inputs in milk production viz., green fodder, dry fodder, concentrate and labour in buffalo milk production, concentrate and labour in case of crossbred cow and green fodder in local cow were found to be over utilized. Therefore, use of these inputs should be reduced in order to get the optimum returns from milk production.

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