Milk Production Function And Resource Use Efficiency In Alwar District of Rajasthan

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Abstract:- The study was undertaken in Alwar District of Rajasthan with the objectives to examine the input-output relationships and assess the resource use efficiency in milk production. The study covered 75 cooperative member milk producers and 75 non-cooperative member milk producers. The results of Cobb-Douglas production function revealed that concentrate had positive and significant influence on returns from buffalo milk across all the household categories for both the member and non-member groups. Green fodder and dry fodder were also influenced the returns from milk significantly across all the household categories for both the member and non-member groups with the sole exception of large category of non-member group. D_1 (winter) and D_2 (Rainy) dummy variables were found to be positive and statistically significant. The results of Chow's test clearly revealed that the production functions between member and non-member groups differed significantly. The results of the resource use efficiency revealed that green fodder was over-utilized in small and medium categories for both the member and non-member groups, dry fodder was over-utilized by medium category of member group, concentrate was over-utilized by only medium category of member group and by small & medium categories of non-member group while it was under-utilized by large category of non-member group and labour was over-utilized by only small category of member group.

Keywords:- Concentrate, Dry Fodder, Green Fodder, Labour, Milk, MVP and Resource Use Efficiency.

Introduction:

Alwar District Milk Producers' Cooperative Union functioning under the aegis of Rajasthan Dairy Cooperative Federation has provided impetus to the enhancement of production and marketed surplus of milk in the Alwar district. Therefore, milk production and disposal are expected to have undergone a discernible change. The milk production is influenced by various genetic and non-genetic factors. The non-genetic factors influencing the milk production are quantity and quality of feeds and fodders fed, order of lactation, stage of lactation, herd size, labour use, seasons etc. Hence the selection of suitable variables to study the milk production is very essential. To ensure the optimal use of various inputs used by the milk producers is matter of primary concern. It is important to know whether the inputs owned by milk producers are used efficiently or not. An empirical assessment of determinants of milk production and resource use efficiency are important for planning, projecting and formulating dairy development policies in a particular region. The input-output relationship in milk production and resource use efficiency have been studied by several researchers in the various parts of the country and found different for different areas depending upon the type of milch animals and the milk production technology. No study has been carried out to investigate the milk production function and resource use efficiency in respect of member and non-member households in Alwar district of Rajasthan.

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The present study was undertaken to fill this vital gap with the specific objectives to (i) examine the input-output relationships in buffalo milk production across different categories of households and (ii) study the resource use efficiency in buffalo milk production across different categories of households.

Research Methodology

Alwar District Milk Producers' Cooperative Union was purposively selected from Rajasthan state for the present study. All the societies were stratified into three strata, viz., low, medium and high milk procurement societies on the basis of milk procurement per day using cumulative frequency square root technique. Amongst these societies, six milk procurement societies were randomly selected based on probability proportional to number of societies in each stratum for the present study. In order to have comparative analysis across herd size categories of both the member and non member milk producers, post-classification of households was done with cumulative frequency square root technique with milch animals as the basis of classification into small, medium and large herd size categories (Delenius and Hodges, 1950). From six selected societies, 75 member households were randomly selected based on probability proportional to number of households in each category. Thereafter, an equal number of non-member households (75) of almost similar resource situation were selected from each category of households in the same society villages to serve as valid basis of comparison. Thus, a total of 150 study during the year 2005-06. The primary data were households were randomly selected for the present collected with help of well structured pre-tested schedule by personal interview/enquiry method. The selected households were visited once in each of the three seasons, viz., summer (March-June), rainy (July-October) and winter (November-February), for the collection of relevant information. The data were collected on milk production, quantity of green fodder, dry fodder, concentrate and miscellaneous expenditure along with their monetary values.

Analytical Framework

Milk Production Function: 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 was as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, D_1, D_2)$

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

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

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

X_3 = Value of concentrate fed per animal per day (Rs.)

X_4 = Value of labour employed per animal per day (Rs.)

X_5 = Value of veterinary services per animal per day (Rs.)

Pooled milk production functions were also fitted using seasonal dummies. Two seasonal dummy variables were introduced as under:

D_1 = 1, if winter season, D_1 = 0, otherwise D_2 = 1, if rainy season, D_2 = 0, otherwise

Linear and Cobb-Douglas forms of production function were tried.

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

Cobb-Douglas $Y = a \prod_{i=1}^{5} x_i^{bi} e^u$ 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 and 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 determination. Hence, results of the same have been used for analysis and interpretation in the study.

Chow's Test: Chow's test was carried out to test the hypothesis whether production functions of member and non-member group are statistically different. The null and alternative hypotheses for testing equality of function for member and non-member group through Chow's test are given as follows:

H_o; $b_m = \beta_{nm}$ i.e. there is no difference between the functions fitted for member and non-member group.

H_i; $b_m \neq \beta_{nm}$ i.e. there is difference between the functions fitted for member and non-member group.

F value for testing the above hypothesis was computed as follows

$$F^* = \frac{\left[\sum e_p^2 - \left(\sum e_m^2 + \sum e_{nm}^2\right)\right] / K}{\left(\sum e_m^2 + \sum e_{nm}^2\right) / (n_1 + n_2 - 2K)}$$

The observed F* ratio was compared with the theoretical value of $F_{0.05}$ (or other levels of significance) with $v_1 = K$ and $v_2 = (n_1 + n_2 - 2K)$ degrees of freedom. If $F^* > F_{0.05;}$ (k, $n_1 + n_2$-2k) d.f., then the null hypothesis is rejected at 5 per cent level of significance. The two functions differed significantly.

Marginal Value Productivity and Resource Use Efficiency: Marginal value productivity of inputs for Cobb-Douglas production function was worked out using the relation, $MVP_i = \hat{b}_i \frac{\bar{Y}}{\bar{X}}$. Where, $\bar{Y}$ and $\bar{X}$ are the geometric means of output Y and respective i[th] inputs and $\hat{b}_i$ is the estimated regression coefficient associated with i[th] inputs.

Resource use efficiency of inputs measures whether or not the inputs are used optimally. A necessary condition for this is that its MVP should be equal to its price. Mathematically, there exists resource efficiency in respect of the use of i[th] inputs, if $MVP_i = P_i$, where, P_i is the unit price of i[th] inputs. In order to examine the resource use efficiency, the 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] inputs from its unit price, are termed as resource use inefficiency. The higher the difference between MVP of an input and its price, the higher is the resource use inefficiency and vice versa. Further t-test was used to test the statistical significance of the difference between the MVP of i[th] inputs 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] inputs. Standard errors in case of Cobb-Douglas forms of production function was worked out as $SE(MVPi) = SE(\hat{b}_i)\frac{\bar{Y}}{\bar{X}}$. Since the mathematical form selected was Cobb Douglas and *SE* ($\hat{b}_i$) is the standard error of estimated partial regression coefficients associated with i[th] inputs.

Research Findings And Interpretation

Input-Output Relationship: Milk production function describes input-output relationship in milk production. Cobb-Douglas production function for buffalo milk in the case of member and non-member groups was fitted and the results regression analysis are presented in Table 1.

A close perusal of the Table 1 of revealed that the coefficients of multiple determination (R^2) were ranged from 0.58 (medium category) to 0.74 (large category) for the member group and from 0.58 (small category) to 0.73 (large category) for the non-member group. This indicated that total variations in returns from milk were explained by the variables included in the selected regression model ranged from 58 per cent (medium category) to 74 per cent (large category) for the member group and from 58 per cent (small category) to 73 per cent (large category) for the non-member group.

Table1. Estimates of parameters of Cobb-Douglas production function for buffalo milk

Category/ Variable	N	Constant	Regression Coefficients							R^2	Chow test value
			Value of Green Fodder (X_1)	Value of Dry Fodder (X_2)	Value of Concentrate (X_3)	Value of Labour (X_4)	Veterinary Expenditure (X_5)	D_1 (Winter)	D_2 (Rainy)		
Member											
Small	115	1.4145	0.0795** (0.052)	0.6863* (0.1250)	0.5284** (0.1137)	0.1894* (0.0912)	0.0223 (0.0356)	0.0565* (0.0140)	0.0923** (0.0241)	0.61	11.6086**
Medium	201	2.1227	0.0543** (0.0212)	0.3338** (0.0682)	0.3133** (0.0355)	0.5311** (0.0980)	0.0278 (0.0366)	0.0928** (0.0095)	0.0486** (0.0161)	0.58	15.9386**
Large	94	1.5403	0.4036** (0.1015)	0.3714** (0.1037)	0.6887** (0.1355)	-0.0043 (0.0929)	-0.0364 (0.0368)	0.0673** (0.0096)	0.0602* (0.0232)	0.74	6.6160**
Non-Member											
Small	138	1.9222	0.0519** (0.0660)	0.7001** (0.1015)	0.3378** (0.0433)	0.1272 (0.0935)	0.0107 (0.0105)	0.0835** (0.0137)	0.1255** (0.0190)	0.58	--
Medium	129	1.7090	0.0595** (0.0209)	0.5777** (0.1198)	0.2357** (0.0255)	0.4403** (0.1561)	-0.0015 (0.0150)	0.0863** (0.0144)	0.1018** (0.0262)	0.66	--
Large	50	1.9041	0.2965 (0.1961)	0.1177 (0.1963)	0.8999** (0.1476)	0.0466 (0.1798)	-0.0874 (0.0826)	0.1560** (0.0202)	0.1123** (0.0414)	0.73	--

Figures in parentheses indicate standard error of regression coefficients * Significant (P<0.05); ** Significant (P<0.01)

A further perusal of the Table 1 revealed that concentrate appeared to be most important variable influencing return from milk. Its regression coefficient was positive and statistically significant (P<0.01) across all the household categories for both the member and non-member groups indicated greater bearing of concentrate on returns from buffalo milk production. On an average, one per cent increase in the expenditure on concentrate resulted in an increase of 0.5284, 0.3133 and 0.6887 per cent in returns from milk in small, medium and large category of member, respectively and 0.3378, 0.2357 and 0.8999 per cent in returns from milk in small, medium and large category of member, respectively. Green fodder was observed to be next important variable to influence the returns from milk significantly across all the household categories for both the member and non-member groups with the sole exception of large category of non-member group. Regression coefficients of dry fodder like green fodder were also influenced the returns from milk significantly across all the household categories for both the member and non-member groups with the sole exception of large category of non-member group. The regression coefficients of labour input was found to have positive and significant impact on returns from milk on small and medium category in the case of member group and only medium category in the case of non-member groups. The regression coefficients of veterinary expenditure were not found to be statistically significant across all the household categories for both the

member and non-member groups. The seasonal dummy variables (D_1 and D_2) were used to examine the effect of a particular season on returns from milk. It was observed that both D_1 and D_2 dummy variables were found to be positive and statistically significant. This indicated that returns from buffalo milk were significantly differed in winter and rainy seasons as compared to summer season. The results of Chow test clearly indicated that two functions for member and non-member groups differed significantly ($P<0.01$). A similar result was reported by Shiyani (1993).

(b) Resource Use Efficiency

The marginal value productivities (MVPs) of inputs used in buffalo milk production in comparison to their respective prices are presented in Table 2. The marginal value productivity of green fodder was positive and significantly lower than their price of this input in the case of small and medium categories for member and non-member groups. It indicated that green fodder was over-utilized in the case of small and medium categories for both the member and non-member groups. Therefore, use of this input should be decreased further by farmers of these categories for getting higher returns from milk production. The marginal value productivity of dry fodder was positive and significantly lower than its price only in the case of medium category of member group. It indicated that dry fodder was also over-utilized in the case of medium category. This calls for decrease in the feeding of dry fodder in order to increase the return from milk by farmers of this category. The marginal value productivity of concentrate was positive and significantly lower than their price only in case of medium category of member group and in the case of small and medium categories of non-member group while it was positive and higher than its price in the case of large category of non-member group. This indicated that concentrate was over-utilized by medium category of member group and small & medium categories of non-member group while it was under-utilized by large category

Table 2. Comparison of MVPs of inputs with their prices for buffalo milk production across household categories

Category/Inputs	Member			Non-member		
	Small	Medium	Large	Small	Medium	Large
Green fodder						
MVP	0.1613	0.1138	0.7994	0.0848	0.1018	--
Price	1.00	1.00	1.00	1.00	1.00	--
Difference in MVP & price	-0.8387** (0.0310)	-0.8862** (0.0446)	-0.2006 (0.2012)	-0.9252** (0.0262)	-0.8982** (0.0358)	--
Dry fodder						
MVP	1.2398	0.6972	0.7332	1.3107	1.0080	--
Price	1.00	1.00	1.00	1.00	1.00	--
Difference in MVP & price	0.2398 (0.2259)	-0.3028** (0.1425)	-0.2668 (0.2049)	0.3107 (0.1902)	0.0080 (0.2090)	--
Concentrate						
MVP	1.1455	0.6971	1.4301	0.6566	0.4347	2.2663
Price	1.00	1.00	1.00	1.00	1.00	1.00
Difference in MVP & price	0.1455 (0.2467)	-0.3029** (0.0790)	0.4301 (0.2814)	-0.3434** (0.0842)	-0.5653** (0.0720)	0.2660** (0.3719)
Labour						
MVP	0.3929	1.0703	--	--	0.8542	-
Price	1.00	1.00	--	--	1.00	-
Difference in MVP & price	-0.6071** (0.1894)	0.0703 (0.1976)	--	--	-0.1458 (0.3029)	-

Figures in parentheses indicate standard errors of difference. ** Significant ($P<0.01$)

of non-member group. This indicates that in order to get more return from milk production, buffaloes should be fed less concentrate by medium category of member group and small & medium categories of non-member group while buffaloes should be fed more concentrate by large category of non-member group. The marginal value productivity of labour was also positive and significantly lower than their price only in the case of small category of member group which indicated over utilisation of labour on this category. This calls for decrease in the use of labour in order to increase the return from milk.

Conclusions:

The results of the study revealed that concentrate, green fodder and dry fodder were the important determinants of buffalo milk production. Therefore, these factors should be considered by policy makers and dairy cooperatives in order to increase the returns from buffalo milk. The returns from buffalo milk were significantly higher in winter and rainy seasons as compared to summer season. In order to get higher returns from buffalo milk production, use of green fodder should be decreased by small and medium categories of both the member and non-member groups, dry fodder should be reduced by medium category of member group, concentrate should be reduced by medium category of member group as well as by small & medium categories of non-member group while it should be increased by large category of non-member group and use of labour should be reduced by small category of member group.

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