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Milk Production Function and Resource Use Efficiency in Hilly District of Himachal Pradesh

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ABSTRACT

The present study was undertaken in the Shimla district of Himachal Pradesh state to analyze the resource use efficiency of milk production in sampled households. The sample of 60 milk-producing households was selected using a multistage random sampling technique. The data were collected from three blocks of Shimla district, namely Mashobra, Rampur, and Rohru, in the year 2020-21. Various milk production functions like linear, transcendental, exponential, and Cobb-Douglas were tried to study the resource use efficiency. Still, ultimately, Cobb-Douglas production function was found the best fit for the present study. The study's results revealed that concentrate and green fodder were the critical determinants of milk production. It was found that for both crossbred and local cows, green fodder and concentrate were underutilized in the study area. Dairy farmers can increase the productivity of milch cattle by supplying more of these inputs in the study area.

Keywords: Milk production, Resource-use efficiency, Cobb-Douglas production, Multistage random sampling technique

Dairying is an essential segment of the livestock sector and is considered one of the viable options for diversifying the agricultural economy. India is the largest producer of milk in the world with 187.75 million tonnes of annual production (Anonymous. 2019a), and the per capita availability of milk in 2018-19 was 394 grams per day as against the world average of 302 grams (FAO, 2020). India has been leading other nations in milk production for an extended period. The country used to be milk deficient and imported milk from other countries to serve its growing population. The journey from being a milk deficit country to becoming the world's largest milk-producing nation has been exemplary. It took years to develop a sector that led to achievements in food security, generating employment opportunities for women, boosting a regular source of income for households in rural areas, and reducing poverty. Himachal Pradesh, a north-western Himalayan state, has varied altitudes, topography, and climate have made this state home to a wide variety of plants and animals. Raising livestock is an integral component of the rural economy in Himachal Pradesh which plays a pivotal role in improving the socio-economic conditions of rural masses. About 87.95 percent of the total landholding was owned by the state's marginal and small farmers. The average holding size is shallow at about 1.00 ha (Anonymous, 2019b). A minor land base inspires farmers to practice dairying as a source of income subsidiary to agriculture. The farmers can profit more from dairy farming as it

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offers promising employment opportunities and handsome economic returns.

In Himachal Pradesh, the cattle population was 18.28 lakh which constitutes 10.70 lakh and 7.58 lakh of crossbred and indigenous breeds, respectively, while the population of buffaloes was 6.46 lakh in 2019. The population of adult female bovines in Himachal Pradesh was 13.01 lakh in 2018-19 (Anonymous, 2019c). In terms of milk production, Himachal ranks 20th among the country's different states and has a per capita availability of 565 grams as against the national average of 394 grams. Shimla district was selected for the present study, which is situated in the sub-temperate region and holds 3rd rank in milk production in the state. Several studies have been carried out in the different agro-climatic zone of India (Meena *et al.* 2012; Singh *et al.* 2012; Sharma *et al.* 2014; Rangnath *et al.* 2015; Vishnoi *et al.* 2015; Lalrinsangpuii and Malhotra, 2016; Jaiswal *et al.* 2017). But very few studies have been carried out in Himachal Pradesh. The study was taken up as an essential step in this direction besides providing information on the resource use efficiency of milk production in the study area (whether resources are under-utilized or overutilized).

MATERIALS AND METHODS

Study Area

The Shimla district, the hilly state of Himachal Pradesh was selected purposively based on milk production and cattle population to examine the resource use efficiency in milk production. Out of the twelve blocks, three blocks were selected randomly, and from each block, 2 gram-panchayat were selected randomly. Then after, two villages were selected randomly from each gram panchayat, ultimately, 5 milk-producing households were selected from each village, thus making a total of 60 dairy farmers.

Data Collection

The primary data were collected from the sample households by conventional survey method using a well-structured schedule through personal interviews. The primary data on demographic features such as family size, age, education, occupation, economic parameters, and cost of milk production were collected from the selected households in the study area for the year 2020-21.

DATA ANALYSIS

Specification of the Milk Production function

Milk production is a complex variable that is influenced by many explanatory variables. In the present study, the production function was employed to estimate the resource-use efficiency of milk production. The following production function is used for the economic analysis-

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

Y = Value of milk produced/animal/day (₹)

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

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

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

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

X_5 = Value of miscellaneous expenses/ animal / day (₹)

The choice of a specific functional form was based on economic (prior criteria) and statistical criteria (first-order test), and coefficient of multiple determinations (R^2). In the present study, four types of functions were tried, which are given below:

Linear: $Y = a + \sum_{i=1}^{n} b_i X_i + u$

Cobb Douglas: $Y = a \prod_{i=1}^{n} X_i^{b_i} e^u$

Transcendental: $Y = a \prod_{i=1}^{n} X_i^{b_i} e^{b_i X_i}$

Exponential: $Y = a \prod_{i=1}^{n} e^{b_i X_i}$

where,

Y = Output; X_i = i^{th} input used; a = Constant term; b_i = Partial regression coefficient of the i^{th} input to be estimated; u = Random error normally distributed with zero mean and constant variance; e = Base of natural log

In the present study, we measure the output (Y) and inputs (X_i) into monetary values rather than their physical quantities. This was done because the

quality of feeds and fodders differ from one dairy farmer to the other and can be more appreciably reflected in value terms.

Marginal Value Productivity (MVP)

Marginal value productivity of inputs from the most appropriate milk production function (Cobb Douglas in the present case) was worked out -

$$MVP_i = bi\frac{\underline{Y}}{\underline{X}_i}$$

where,

MVP_i = Marginal value product of i^{th} input

$\underline{Y}$ = Geometreic mean of Y

$\underline{X}_i$ = Geometric mean of i^{th} input

bi = Regression coefficient associated with the i^{th} input.

Resource-use efficiency

The resource-use efficiency showed whether a particular input is efficiently used or not. The input is used efficiently if the MVP of the input is equal to its unit price.

$$MVP_i = P_i$$

where,

P_i = Unit price of the i^{th} input

To estimate the resource use efficiency, the marginal value productivity of various inputs was calculated for significant regression coefficients in the estimated milk production function. Any deviation of MVP of input from its unit price represents the inefficiency of the resource use. The higher the difference between the MVP of an input and its unit price, the higher the resource use inefficiency and vice versa. To test the statistical significance of the difference between MVP and its unit price, the t- statistics were used in the present study.

If the MVP of any input is significantly higher than its unit price represents that the input can be used further to increase productivity. In comparison, a significantly lower MVP of input is being used in excess and hence needs reduction.

$$t\text{-statistic: } t = \frac{MVP_{x_i} - P_{x_i}}{S.E.\left(MVP_{x_i}\right)}$$

where,

$S.E.(MVP_{xi})$ = Standard Error of MVP of i^{th} input.

P_{xi} = Unit price of i^{th} input

In the case of the Cobb-Douglas production function standard error of MVP_{xi} was calculated by the formula:

$$S.E.\left(MVP_{x_i}\right) = SE\left(b_i\right) \times \frac{\underline{Y}}{\underline{X}}$$

where,

b_i = Partial regression coefficient of the i^{th} input to be estimated

$\underline{Y}$ = Geometric mean of output Y

$\underline{X}$ = Geometric mean of input X

RESULTS AND DISCUSSION

In the regression analysis, variables' choice, and specification are crucial. Even if a single unwanted variable is included or a relevant variable is omitted, the fitted model becomes biased in the economic sense (Heady and Dhillon, 1961). Amongst all production functions tried, the Cobb Douglas function was found the best fit for both local cows and crossbred cows keeping in view the significance, the sign of explanatory variables and value of R^2, hence was preferred for further economic analysis. The Cobb Douglas milk production functions of local and crossbred cows are given below:

Table 1 revealed that the adjusted coefficient of determination value (R^2) was 0.95, indicating that 95 percent of the variation in the gross income was explained by the independent variables included in the production function model. The coefficients of green fodder and concentrate were positive and significant ($p<0.05$) with the coefficient values of 0.27 and 0.59, respectively, which shows that a one percent increase in expenditure on green fodder and concentrate caused 0.27 and 0.59 percent increase in gross returns keeping other factors constant. This conforms with earlier studies carried out (Meena *et al.* 2012) in the Alwar district of Rajasthan. The

Table 1: Estimated parameters of Cobb Douglas production function for local cows

Constant	Estimated Parameters						
	Green fodder	Dry fodder	Concentrate	Labour	Miscellaneous Expenses	R^2	n
3.820	0.269*	-0.014	0.580*	0.041	0.132	0.95	60
(0.339)	(0.127)	(0.169)	(0.204)	(0.255)	(0.092)		

Note: ** Significant ($p < 0.01$) and *Significant ($p < 0.05$); Figures in parentheses indicate the standard error of the estimate.

Table 2: Estimated parameters of Cobb Douglas production function for crossbred cows

Constant	Estimated Parameters						
	Green fodder	Dry fodder	Concentrate	Labour	Miscellaneous Expenses	R^2	n
3.257	1.297*	-0.056	1.090**	-0.212	0.876	.92	60
(0.899)	(0.420)	(0.719)	(0.532)	(0.382)	(0.607)		

Note: ** Significant ($p < 0.01$) and *Significant ($p < 0.05$); Figures in parentheses indicate the standard error of the estimate.

production function analysis indicated that milk productivity could be increased by feeding green fodder and concentrates effectively. The table further revealed that the regression coefficient of labor was positive and not significant, while dry fodder was found negative but not significant.

The milk production function for milking crossbred cows revealed that 92 percent of the variation in returns from milk was explained by expenditures on green fodder, dry fodder, concentrates, labor, and miscellaneous expenses (Table 2). Among the five explanatory variables included, the regression coefficient of green fodder and concentrates was found to be positive and significant, implying that milk production of crossbred cows could be significantly increased through the efficient use of these inputs. However, the regression coefficient of dry fodder, labor, and miscellaneous expenses was negative and non-significant in the study area.

Resource-use efficiency in milk production

To examine the resource use efficiency, the marginal value productivity (MVPs) of inputs whose regression coefficients were found statistically significant in milk production function were compared with their respective unit price. A significantly higher MVP of input from its unit price shows that more of that input can be used to increase productivity, while a significantly lower MVP of input than its unit price indicates that the input used is in excess and needs rationalization. The marginal value products (MVP) of significant inputs for both crossbred and local cows are given in Table 3.

Table 3: Marginal Value Product for local and crossbred cows

Input statistics	Local Cow	Crossbreed
Green Fodder		
MVP	1.50	5.76
Input Price (MFC)	1.00	1.00
Difference	0.50*	4.76*
S.E.	0.24	1.87
t-value	2.10	2.55
Concentrate		
MVP	1.76	4.47
Input Price (MFC)	1.00	1.00
Difference	0.76	3.47**
S.E.	0.67	1.58
t-value	1.13	2.19

Note: ** Significant ($p < 0.01$) and *Significant ($p<0.05$).

Table 3 revealed that for both local and crossbred cows, the difference between marginal value product (MVP) and marginal factor cost (MFC) for green fodder and concentrate were positive and significant, indicating that both the inputs were under-utilized in the study area. The study's findings revealed that the milk productivity of milch animals could be increased by the increase in the quantity of green fodder and concentrate.

This conforms with the findings of earlier studies by Sharma *et al.* (2014), Lalrinsangpuii and Malhotra (2016), and Jaiswal *et al.* (2017), who reported the concentrates were underutilized in the milk production of crossbred cows in the Malwa region of Madhya Pradesh, Mizoram and Raipur district of Chhattisgarh respectively.

CONCLUSION

The results of the study revealed that concentrate and green fodder are two major determinants in milk production. Concentrate and green fodder were found underutilized in the study area. Therefore, it is suggested that dairy farmers should put more effort into efficiently utilizing concentrates and green fodder to increase the milk productivity of the milch animals. The green fodder was optimally used in the case of local cows. Feed concentrate is a significant factor for milk yield; the availability of low-cost good, quality concentrate to the farmers will help increase the average milk yield in the region. Farmers may be provided training on the preparation of such concentrates from locally available materials. The feed cost was the major constituent of the total gross cost. Therefore, farmers should be encouraged to cultivate leguminous and other fodder species on their land.

REFERENCES

Anonymous. 2019a. *National Accounts Statistics*. Central Statistical Organisation. Ministry of Statistics and Programme Implementation, Government of India. 408p.

Anonymous. 2019b. *Basic Animal Husbandry Statistics*. Department of Animal Husbandry, Dairying and Fisheries. Ministry of Agriculture & Farmers Welfare, Government of India. 132p.

Anonymous. 2019c. *Livestock Census*. Department of Animal Husbandry, Dairying and Fisheries. Ministry of Agriculture & Farmers Welfare, Government of India. 119p.

Bhagat, G., Singh, S.P., Dwivedi, S., Bhat, A., Raj, L., Sharma, S. and Singh, M. 2022. Profitability and Resource Use Efficiency of Mustard in Jammu District of J&K (UT). *Agro. Econ. Int. J.*, **09**(01): 107-110.

FAO. 2020. World Food and Agriculture - Statistical Yearbook 2020. Rome, pp. 351.

Heady, E.O. and Dhillon, J.L. 1961. Agricultural Production Function. Iowa State University Press, Ames, Iowa, pp. 73-107.

Jaiswal P., Ghule A.K., Singh S.P. and Gururaj B. 2017. Study on Milk Production Function and Resource use Efficiency in Raipur district of Chhattisgarh. *Multilogic in Science,* **6**(19): 121-124.

Lalrinsangpuii and Malhotra, R. 2016. Resource Use Efficiency in Milk Production in Mizoram State of North-East India. *J. Anim. Res.,* **6**(3): 431-435

Meena, G.L., Burark, S.S., Pant, D.C., Sharma H. and Yogi, R.K. 2012. Milk production function and resource use efficiency in Alwar District of Rajasthan. *Int. J. Sci. Technol. Res*., **1**(8): 115-119.

Meenakshi, Satihal, D.G., Joshi, A.T., Patil, S.S. and Moulasab. 2022. Resource Use Efficiency of Mustard and Bengalgram Cultivation in Paddy Fallows in Raichur District. *Agro. Econ. Int. J.*, **09**(01): 43-48.

Rangnath, P.S., Agarwal, S.B. and Goutam Das. 2015. Study on resource use efficiency in milk production in Western Maharashtra, India. *Ind. J. Anim. Res*., **49**(4): 523-526.

Sharma, S.K., Malhotra, R. and Mahajan, S. 2014. Resource-use efficiency in milk production in the Malwa region of Madhya Pradesh. *Ind. J. Dairy Sci*., **67**(6): 531-534.

Vishnoi S., Pramendra, Gupta V. and Pooniya R. 2015. Milk production function and resource use efficiency in Jaipur District of Rajasthan. *Afr. J. Agric. Res*., **10**(32): 3200- 3205.