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RESEARCH ARTICLE

# Efficiency of resources use in cattle milk production in the lower Brahmaputra valley zone of Assam, India

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**Abstract:** From the perspective of profit-making in dairy farming, it is essential to understand how to make the most of limited resources for milk production. It is essential to know if the resources owned and utilized by the farmers were utilised effectively or not. The study was undertaken to analyze the resource use efficiency in the cattle milk production in the Lower Brahmaputra Valley Zone of Assam. Multi stage random proportionate sampling technique was undertaken from a cluster of villages and a total of 172 dairy farmers were randomly selected from the two districts, namely Kamrup and Barpeta for the study. Data was collected through the interview method using a pre tested semi structured interview schedule. To estimate the productivity of resources in milk production, Cobb Douglas Production Function was used. The co-efficient of multiple determinations was 0.825 and 0.796 for the local and crossbred cattle, indicating that the five variables selected for the analysis had explained 82.5 per cent and 79.6 per cent variation in local and crossbred cattle milk production respectively. The results of the Cobb-Douglas Production Function revealed that variables like concentrate, green fodder and labour had a positive and highly significant influence on milk production of local cattle whereas for crossbred cattle green fodder, concentrate, dry fodder and veterinary charges had a significant influence. The result of allocative efficiency of resources in milk production revealed that concentrates, labour and veterinary charges were under-utilized, whereas green fodder and dry fodder were over-utilized.

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## Introduction

The efficiency of resource use in cattle milk production refers to how effectively resources such as feed, water, land, and energy are utilized to produce milk. Efficient resource use is important for sustainable and profitable milk production while minimizing environmental impacts. India is the largest producer of milk in the world accounting for an annual milk output of 209.96 Mt in 2020-21 (NDDB, 2020). India accounts for 21 per cent of the global milk production. The organized sector comprises of only 34 per cent of the total milk production in the country. During the last few decades, India's milk producers have transformed Indian dairying from stagnation to world leadership. In India, dairying is recognized as an instrument for social and economic development. Dairy sector plays a significant role in supplementing family income and generating gainful employment in rural areas besides providing cheap nutritional food to millions of people. The growth of the dairy sector during the last three decades has been impressive. The nation's milk supply comes from millions of small producers. India ranks first in the world in milk production. The per capita availability of milk is 444 grams in 2020-2021. Milk emerged as one of the biggest contributors to the value of agricultural output in the country. Increase in milk production with limited resources like quality and quantity of feed, labour, genetic potential of the animal and 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. Resource use efficiency comprised the distribution of a given amount of scare factor among the set of alternatives in the production so as to maximize the profit (Ganeshkumar et al. 2000). Education of farmers plays a significant role in both technical and allocative efficiency (Kumbhakar et al. 1991). An empirical assessment of determinants of milk production and resource use efficiency is important for planning, dairy development policies in a particular region. This study estimates the various factors of milk production and their levels of allocative efficiency in milk production for local and crossbred cows in the region. Efforts to improve resource efficiency in cattle milk production are ongoing and involve advancements in man-

agement practices, technological innovations, and sustainable farming systems. By optimizing resource use, dairy farmers can enhance productivity, reduce costs, and promote environmental sustainability in the dairy industry in the country.

**Materials and Methods**

For the present study, Lower Brahmaputra Valley Zone of Assam was selected purposively owing to highest milk production from the region in the state. In the Lower Brahmaputra Valley Zone of Assam, the dairy farmers were selected randomly from the two districts of Kamrup and Barpeta for the present study. From the selected districts, a total of 172 dairy farmers were selected randomly using the multi stage random proportionate sampling technique from a cluster of villages. The field survey for this study was conducted during the months of November and December 2022 and the data was collected from the sample units related to the year 2022-23.

Information relating to various aspects of dairy farming was collected from selected farmers by survey method with a well-designed and pre-tested standardized interview schedule. Details of inputs used like green fodder, dry fodder, concentrates with their quantities and price, labour employed with wage particularly veterinary and breeding expenses, miscellaneous expenses and data on outputs were also collected from the dairy farmers. The data collected were analyzed with a view to achieve the sole objective of the study.

**Analytical Framework**

The log- log regression analysis was used to study the relationship between milk and different factors influencing it. The Cobb-Douglas production was used to obtain the parameters for the measurement of productivity of resources in milk production. Various studies are available on the use of Cobb-Douglas production function for the measurement of productivity of resources in milk production (Kumar and Shukla, 2017; Meena et al. 2012 ; Venkatesh et al. 2011).

The Cobb-Douglas production function for milk production was specified and defined as follows:

$$\ln Y = ?0 + b1\ln X1 + b2\ln X2 + b3\ln X3 + b4\ln X4 + b5\ln X5 + \mu$$

Where,

Y = Milk produced per annum (lit)

?0 = constant

X1 = Concentrates fed per annum (Kg)

X2 = Green fodder fed per annum (Kg)

X3 = Dry fodder fed per annum (Kg)

X4 = Labour employed per annum (man-days)

X5 = Veterinary services per year (?)

μ = error term

Determining the Efficiency of Resource Use of Cattle Milk

The following ratio was used to estimate the relative efficiency of resource use (r):

$$r = MVP/(MFC)$$

Where:

MFC = Marginal Factor Cost (cost of one unit of a particular resource)

MVP = Marginal value product, calculated by multiplying the MPP by the price of output

$$MVP = biY/X\ Py$$

Where,

Y = geometric mean of total output

X = geometric mean of particular input

bi = regression coefficient of that input

Py= price per unit of output

Decision rule

If r = 1, resource is efficiently utilized,

If r > 1, resource is under-utilized

If r < 1, resource is over utilized.

Economic optimum takes place where MVP = MFC ,i.e, production is said to be efficient when MVP =MFC (Rajendran and Prabaharan, 1989). If r is not equal to 1, it suggests that resources are inefficiently utilized. Adjustments could be therefore made in the quantity of inputs used and costs in the production process to restore r = 1. Any deviation of MVP of ith inputs from its unit price are termed as resource use inefficiency.

**Results and Discussion**

In a production process, the objective is to co-ordinate and utilize resources in such a manner that they together yield the highest net returns. This is optimum use of resources in production. To study the resource use efficiency of factors in milk production, a log- log production function was fitted to the data. The independent variables used were concentrate feed (X1), green fodder(X2),

dry fodder(X3), labour(X4), and veterinary charges(X5). The result of the regression analysis in respect of the production function is presented in Table 1 and Table 2.

From the Table 1, it could be observed that for local cattle the co-efficient of multiple determination was 0.825, which indicated that the five variables selected for the analysis have explained 82.5 per cent variation in total milk production. Among the five variables, the green fodder and labour variables were significant at one percent level and concentrate fed was significant at five percent level. The above analysis clearly indicated the importance of concentrates, green fodder and labour input for higher milk production and profits. Similar findings were reported by Singh et al. (2010). The variable veterinary charges and dry fodder were not having any significant influence on milk production in the study area. The marginal productivity of concentrates, green fodder and labour was 0.259, 0.346 and 0.258 respectively explaining that one percent increase in these variables would increase the milk production by 0.259, 0.346 and 0.258 per cent respectively ceteris paribus.

From the Table 2, it could be observed that the co- efficient of multiple determinations for the crossbred milch cattle was 0.796, which indicated that the five variables selected for the analysis have explained 79.6 per cent variation in total milk production. Among the five variables, the concentrate feed and green fodder were significant at one per cent and five per cent level whereas dry fodder and veterinary charges were significant at ten per cent level. The above analysis clearly indicated the importance of concentrates, green fodder, veterinary charges and dry fodder for higher milk production and profits. Similar findings were reported by Singh et al. (2010). The labour input was not having any significant influence on milk production of crossbred milch cattle in the study area. The marginal productivity of concentrates, green fodder, dry fodder and veterinary charges was 0.461, 0.257, 0.017 and 0.173 respectively explaining that one per cent increase in these variables would increase the milk production by 0.461, 0.257, 0.017 and 0.173 per cent respectively ceteris paribus. Previous studies by Sharma and Singh (1993) and Ahuja et al. (1999) observed the strong relationship between the concentrates and milk production.

Table 3 revealed that for the local milch cattle, the difference between marginal value product (MVP) and marginal factor cost (MFC) for green fodder and concentrate were positive 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

**Table 1:** Regression co-efficients for milk production of local milch cattle in the study area

| Variables | Regression co-efficient | t value | p-value |
|---|---|---|---|
| Constant | 0.148 | 0.729 | 0.147 |
| Concentrate feed($X_1$) | 0.259** | 5.897 | 0.010 |
| Green fodder($X_2$) | 0.346*** | 1.871 | 0.000 |
| Dry fodder($X_3$) | 0.029 | 1.602 | 0.472 |
| Labour($X_4$) | 0.258*** | 3.378 | 0.004 |
| Veterinary charges($X_5$) | 0.048 | 1.392 | 0.124 |
| N | 172 | | |
| $R^2$ | 0.825 | | |
| Adjusted $R^2$ | 0.818 | | |

**Note:** *** and ** indicates ($p<0.01$) and ($p<0.05$)

**Table 2:** Regression co-efficients for milk production of crossbred milch cattle in the study area

| Variables | Regression co-efficient | t value | p-value |
|---|---|---|---|
| Constant | 0.326 | 0.635 | 0.354 |
| Concentrate feed($X_1$) | 0.461*** | 4.317 | 0.001 |
| Green fodder($X_2$) | 0.257** | 1.940 | 0.040 |
| Dry fodder($X_3$) | 0.017* | 1.613 | 0.078 |
| Labour($X_4$) | 0.328 | 2.279 | 0.273 |
| Veterinary charges($X_5$) | 0.173* | 1.348 | 0.015 |
| N | 172 | | |
| $R^2$ | 0.796 | | |
| Adjusted $R^2$ | 0.781 | | |

**Table 3:** Resource use efficiency for local and crossbred milch cattle

| Particulars | MVP | MFC | Difference | SE of MVP | MVP/MFC | t-value |
|---|---|---|---|---|---|---|
| | | | Local cows | | | |
| Green fodder | 3.84 | 2.00 | 1.84 | 2.15 | 1.92 | 4.57 |
| Concentrate | 12.41 | 10.00 | 2.41 | 23.57 | 1.24 | 1.96 |
| Labour | 0.84 | 1.00 | -0.16 | 1.43 | 0.84 | 0.76 |
| | | | Crossbred cows | | | |
| Green fodder | 3.42 | 2.00 | 1.42 | 2.12 | 1.71 | 1.96 |
| Dry fodder | 3.16 | 4.00 | -0.84 | 3.76 | 0.79 | 1.58 |
| Concentrate | 7.03 | 10.00 | -2.97 | 0.86 | 0.70 | 4.07 |
| Veterinary charges | 9.39 | 8.00 | 1.39 | 28.72 | 1.17 | 2.46 |

fodder and concentrate. The results also revealed that the difference between marginal value product (MVP) and marginal factor cost (MFC) for labour was found to be negative indicating that the labour were over utilised in the region. It shows that there is no possibility of augmenting local cow milk production by using more of this input. Thus, there is a potential to increase the milk production by judicious feeding of green fodder and concentrate in the study area. The results corresponds with the findings of Lalrinsangpuii and Malhotra (2016) who revealed positive marginal value productivity of green fodder and concentrate for local cow milk production in Mizoram and the findings of Kumar and Shukla (2017) in western Uttar Pradesh.

Also from the Table 3 it could be observed that unlike the local cattle, in case of the crossbred cattle the difference between marginal value productivity of inputs and their marginal factor cost was found as positive and statistically significant for the inputs, namely, green fodder and the veterinary charges indicating that green fodder and veterinary expenses were under-utilised in the study area. Thus, there is a potential to increase the milk production by judicious feeding of green fodder. Also, increasing veterinary expenses would help to boost milk production of crossbred cows in the study area. The findings of Singh et al. (2007) in Imphal West district of Manipur and Mahajan and Chauhan (2011) in Ludhiana district of Punjab reported that concentrates were being efficiently utilised for crossbred cows. On the contrary, the results were in contrast with the findings of Kaur and Toor (2022) in rural Punjab who reported that green fodder, dry fodder, concentrates and human labour were over-utilised with negative and statistically significant difference between marginal value productivity of inputs and their marginal factor cost.

## Conclusions

This paper is an attempt to estimate the resource use efficiency of cattle milk production in Lower Brahmaputra Valley Zone of Assam. The study of productivity of resources in milk production revealed that the variables like green fodder and concentrate the difference between marginal value productivity of inputs and their marginal factor cost was positive in case of local milch cattle indicating that both inputs were under-utilized in the study area while the labour variable was insignificant. Moreover, in case of the crossbred milch cattle, the difference between marginal value productivity of inputs and their marginal factor cost for the variables like green fodder and veterinary charges were positive indicating that it was under- utilized and variables like dry fodder and concentrates were over utilized. Since feed and fodder resources encompass a major chunk of the cost of milk production, therefore good care should be taken to use these resources optimally. Further, now a days, labour is a very important resource in milk production, therefore this resource should be used optimally in the milk production system. The study concludes that the technology augmentation in the form of strategic mix of additional inputs, viz. green fodder and concentrates in feed ration optimally.

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## Conflict of interest

The authors declare that there is no conflict of interest regarding the content of the paper.

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