Resource-use efficiency in milk production in Malwa region of Madhya Pradesh

Sandeep Kumar Sharma, Ravinder Malhotra and Sumit Mahajan

Abstract  The study conducted in Indore and Rajgarh districts of Malwa region of Madhya Pradesh collecting data from 160 milk producing households revealed that resource-use efficiency of green fodder for all types of dairy animals was found to be negative and significant indicating over-utilisation of this input which could be due to the fact that data were collected in winter season when plenty of green fodder was available. Therefore, reduced use of green fodder for all the dairy animals will not affect milk production adversely during that particular period. The concentrates were being under-utilised in case of local cows while they were over-utilised in case of buffaloes which calls for reallocation of concentrates from buffaloes in favour of local cattle which will increase the milk production without spending more on concentrates. The concentrates were optimally used in case of crossbred cattle. The Cobb-Douglas production function was found best fit keeping in view sign, significance of regression coefficients and value of $R^2$.

Keywords : Milk production, cobb-Douglas, resource-use, Malwa, efficiency

Introduction

Though there is a significant improvement in milk production in India, yet the dairy business is not found encouraging, due to rearing of local cattle having low productivity. Moreover, the majority of milk producers are smallholders and lack scientific know-how to boost the animal productivity. Milk production is a complex process involving a number of genetic and non-genetic factors. Type of breed and ability for milk secretion by individual animals are the important genetic factors. The important non-genetic factors influencing milk production include the quality of feed and fodder, labour, order of lactation, stage of lactation etc. There are evidences in the studies (Aul et al. 1973; Sharma and Rajpali, 1989; Agarwal et al., 1995; Chamak, 1995; Singh et al., 2006 and Mahajan and Chauhan, 2011) that there is a great variation in relative economic efficiency of different breeds/species of milch animals reared by different categories of the herd size farms due to the variation in genetic potential, feeding and management practices. Various inputs like green fodder, dry fodder, concentrate, labor, etc., are used as input resources in milk production. The knowledge of best use of scarce resources for milk production is essential for profit making in dairy farming as it directly and indirectly affects the milk production. It is thus important to know whether the resources owned by the producers are used efficiently or not. Therefore, estimation of input-output relationship in dairy enterprise is of great significance in determining the optimal level of resource. In view of this, the present paper attempts to analyse the input-output relationship and resource-use efficiency in respect of the use of principal inputs that go in the production of milk in Indore and Rajgarh districts of Madhya Pradesh.

Data and Methodology

Study area

Madhya Pradesh has been purposively selected for the present study because it stands first in indigenous cattle population, fourth in buffalo population and is the seventh largest milk producing state of India with share of 6.3% of the total milk production of the country. The state is divided in 11 agro-climatic zones and Malwa is one of them. Malwa includes 10 districts i.e., Dewas, Dhar (Badnawar & Sardarpur Tehsils.), Indore, Jhabua (Petlawad Tehsil), Mandsaur, Rajgarh, Ratlam, Shajapur, Neemuch, and Ujjain. Malwa region is having 17.02%
(5.09 million) of the bovine population of Madhya Pradesh. This region has 34.80% (highest) cross-bred cattle population of Madhya Pradesh. This region is also having 2.08 million buffaloes (24.20%) of M.P. and is the highest milk producing region of the state with the share of 25.18% out of 6.85 million metric tonnes (Government of Madhya Pradesh, 2010).

Multistage sampling procedure was adopted for selection of state, district, tehsils, and villages. The state of Madhya Pradesh has been purposively selected for the reasons mentioned above. Further, Malwa Plateau region of M.P. was also selected purposively as it is the highest milk producing region and has highest cross-bred population in the state. From the Malwa region, two districts, i.e., Indore and Rajgarh were selected randomly. From each of the selected districts, two tehsils were selected randomly. The two tehsils from Indore district were viz, Mhow and Indore while from Rajgarh district, the two tehsils were Biaora and Rajgarh. From each selected tehsil, one village was selected randomly. The villages selected were Bhagora from Mhow, Pedmi from Indore, Budakheda from Biaora, and Laltalai from Rajgarh tehsil. Thus, a total of four villages were selected randomly.

The Data

After complete enumeration of four selected villages with respect to milch bovine stock, households were categorised into small, medium and large categories using cumulative square root method. A sample of 160 milk producing households were selected from these four villages consisting 70 small, 61 medium, and 29 large milk producing households. The primary data were collected from 160 sample households by conventional survey method using well-structured schedule through personal interview.

Functional Analysis

Milk production is a complex variable, which is influenced by several explanatory variables. The production function shows the relationship between output (milk yield) and inputs (explanatory variables) used in the production process. In the present study, production function analysis was employed to estimate the resource productivity and resource-use efficiency in milk production. The regression equations were fitted for different categories of lactating animals.

Specification of Milk Production Function:

The specification of milk production function used in the present study for functional analysis is as follows:

\[ Y = f(X_1, X_2, X_3, X_4, X_5) \]

Where

\[ Y = \text{Income from milk per animal per day (₹)} \]
\[ X_1 = \text{Expenditure on green fodder per animal per day (₹)} \]
\[ X_2 = \text{Expenditure on dry fodder per animal per day (₹)} \]
\[ X_3 = \text{Expenditure on concentrates per animal per day (₹)} \]
\[ X_4 = \text{Value of labor used per animal per day (₹)} \]
\[ X_5 = \text{Miscellaneous expenses per animal per day (₹)} \]

The choice of a specific functional form was based on statistical criteria, i.e. sign and statistical significance of estimated parameters and co-efficient of multiple determination (R²). Four types of functions were tried which are as follows:

Linear : \[ Y = a + \sum_{i=1}^{n} b_i X_i + u \]
Cobb Douglas : \[ Y = a * \prod_{i=1}^{n} X_i^{b_i} e^u \]
Semi-log (Lin-log) : \[ Y = ln(a) + \sum_{i=1}^{n} b_i lnX_i + u \]
Semi-log (Log-Lin) : \[ lnY = a + \sum_{i=1}^{n} b_i X_i + u \]

Where

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

Ideally, the output (Y) and inputs (X_i) in the above production functions were measured in monetary values rather than their physical quantities; this was done because the quality of feeds and fodders differs from one respondent to the other and can be more appreciably reflected in value terms.

Marginal Value Productivity

In linear function, the regression coefficients (b_i's) of the explanatory variables indicate the MVP of independent variables measured in monetary terms.

\[ MVP_i = b_i \]

In cobb-douglas production function, MVP was worked out by taking the first order partial derivative of output with respect to the concerned input.
where,

\[ Y = \text{Geometric mean of the output Y} \]
\[ (\bar{X}) = \text{Geometric mean of the } i^{th} \text{ input} \]
\[ b_i = \text{Partial regression co-efficient of } X_i^{'} \text{s} \]

Resource-Use Efficiency

Inputs are used efficiently if the MVP of the input is equal to its unit price, i.e.,

\[ MVP_i = P_i \]

where, \( P_i \) is the unit price of the input.

In order to examine the resource-use efficiency, the marginal value productivity (MVP) of various inputs was worked out for significant regression coefficient in the estimated milk production function. Any deviation of MVP of input from its unit price may be 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-statistic given below was used to test the statistical significance of the difference between the MVP of an input and its price. If the difference between MVP of an input and its unit price is statistically non-significant, it indicates that the input is being used efficiently. A significant higher MVP of an input than its price shows that more of the input can be used to increase productivity, while a significantly lower MVP of an input than its unit price indicates that the input is used in excess and needs reduction.

The resource-use efficiency of green fodder for local cow, crossbred cow and buffalo was found to be negative and significant indicating over-utilisation of this input which may be due to the reason that data were collected in winter season at a point of time which was the flush season for greens, hence use of green fodder can be reduced in that season in the study area and its reduced use will not affect milk production adversely. The findings of over-utilisation of green fodder is in complete agreement with Sharma and Rajpali (1989) who reported that green fodder was of great importance in all types of dairy units of Gwalior district, but its value turns out to be negative in rural area due to over-utilisation.

The difference between MVP and unit price of concentrate for local cow was found to be positive and significant indicating under-utilisation of this input and increased use of this input may increase milk production further while for buffalo it was found to be negative and significant indicating its over utilization. Therefore, feeding of concentrates can be reduced in case of buffalo without affecting milk production. But for crossbred cattle, the concentrates were being used efficiently and optimally as revealed by the insignificance of difference MVP and unit price of concentrate. The findings for crossbred cattle are in agreement with Mahajan and
Chauhan (2011) who reported that concentrates were being efficiently utilised in case of crossbred cattle for both rural and peri-urban dairy farms in Ludhiana district.

**Conclusions**

The resource-use efficiency of green fodder for all types of dairy animals was found to be negative and significant indicating over-utilisation of this input which could be due to the fact that data were collected in winter season when plenty of green fodder was available. Therefore, reduced use of green fodder for all the dairy animals will not affect milk production adversely during that particular period. The concentrates were being under-utilised in case of local cows while they were over-utilised in case of buffaloes which calls for re-allocation of concentrates from buffaloes in favour of local cattle which will increase the milk production without spending more on concentrates. The concentrates were optimally used in case of crossbred cattle.

**References**


Table 1  Estimated Parameters of Milk Production Function

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Type of Dairy Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Local Cow</td>
</tr>
<tr>
<td>Constant term</td>
<td>3.04</td>
</tr>
<tr>
<td>Value of Green Fodder</td>
<td>0.14**</td>
</tr>
<tr>
<td>(0.04)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Value of Dry Fodder</td>
<td>-0.04</td>
</tr>
<tr>
<td>(0.08)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Value of Concentrate</td>
<td>0.18**</td>
</tr>
<tr>
<td>(0.02)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Labour</td>
<td>0.07</td>
</tr>
<tr>
<td>(0.07)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Miscellaneous Expenses</td>
<td>-0.03</td>
</tr>
<tr>
<td>(0.05)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>128</td>
</tr>
<tr>
<td>R²</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Figure in parentheses indicate the standard error of regression coefficient.
** Significant at 1 per cent level

Table 2  Resource-Use Efficiency in Milk Production

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Species</th>
<th>MVP</th>
<th>Diff†</th>
<th>S.E</th>
<th>t- value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Fodder</td>
<td>Local Cow</td>
<td>0.1959</td>
<td>-0.8041**</td>
<td>0.0567</td>
<td>-14.1801</td>
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<tr>
<td></td>
<td>Crossbred Cow</td>
<td>0.3096</td>
<td>-0.6904**</td>
<td>0.1043</td>
<td>-6.6214</td>
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<td></td>
<td>Buffalo</td>
<td>0.1798</td>
<td>-0.8202**</td>
<td>0.0617</td>
<td>-16.0089</td>
</tr>
<tr>
<td>Concentrates</td>
<td>Local Cow</td>
<td>2.3838</td>
<td>1.3828**</td>
<td>0.2850</td>
<td>4.8552</td>
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<tr>
<td></td>
<td>Crossbred Cow</td>
<td>0.9519</td>
<td>-0.0480</td>
<td>0.0804</td>
<td>-0.5972</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td>0.7158</td>
<td>-0.2842**</td>
<td>0.0728</td>
<td>-13.0203</td>
</tr>
</tbody>
</table>

**Significant at 1 per cent level of significance