Study on resource use efficiency in milk production in the Scarcity Zone of Western Maharashtra, India

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ABSTRACT
The present study was undertaken in the Scarcity Zone of Western Maharashtra with the objective of examining the input-output relationship and resource use efficiency in milk production. The study revealed that concentrates have positive and significant influence on the milk production from both buffaloes and crossbred cows in the study area. Concentrates were underutilized for both milking buffaloes and crossbred cows. Dairy farmers in Western Maharashtra Scarcity Zone should put more efforts for efficient utilisation of concentrates to increase the milk production. There is a need for technical guidance to farmers particularly regarding scientific feeds and fodder management practices.

Key words: Concentrates, Dry fodder, Green fodder, Resource use efficiency.

INTRODUCTION
Dairying is one of the important sub-sectors of Indian agriculture providing gainful employment and income, particularly to the small and marginal farmers, women and agricultural labourers. It plays an important role in the economy in general and sustainable livelihood of poor people of rainfed agro-ecosystem in particular, because of inherent risk involved in the crop farming due to uncertainty in rainfall and occurrence of recurrent drought (Misra and Ramakrishna, 2007). Maharashtra is one of the largest milk producing states contributing 8044 thousand tonnes (6.60%) to the total milk production of 121.84 million tonnes in India during the 2010-11 (Govt. of India, 2012). The state is comprised of nine agro-climatic zones out of which Western Maharashtra Scarcity Zone (WMSZ) is the second largest zone in terms of area with very low rainfall (500-700 mm) having unequal distribution. Though dairying is the main subsidiary occupation and essential component of mixed farming system in this scarcity zone, farmers are not only ignorant about the extent to which various inputs influence the milk production, but also unaware about the production capabilities of their animals. As the resources are scarce in milk production, it is essential to have the knowledge of best use of resources. Therefore, present study was conducted with the aim of estimating the input-output relationship and resource use efficiency in milk production in the WMSZ. The objective was to understand whether the inputs are under-utilized or over-utilized for milk production.

MATERIALS AND METHODS
Multistage Stratified Random sampling technique was used in the study conducted during 2007 in the WMSZ comprised of eastern parts of Dhule, Nashik, Ahmednagar, Pune, Satara, Kolhapur, Sangli and western parts of Jalgaon, Solapur, Beed and Osmanabad districts. Out of total 11 districts of the WMSZ, two districts i.e., Satara and Sangli were selected at random. Then two taluka i.e., Khatav from Satara and Atpadi from Sangli district were selected at random. Further, four villages i.e., Palshi and Wanzoli from Khatav taluka and Vibhutwadi and Pimpari from Atpadi taluka were selected randomly. Complete enumeration of milk producing households in each of the selected villages was carried out. In all, there were 616 milk producing households in the selected villages. These households were classified in to six categories based on operational land holding viz. landless, marginal (up to 2.5 acre), small (2.5-5 acre), semi-medium (5-10 acre), medium (10-25 acre) and large (above 25 acre). Thereafter, 100 households were selected according to the probability proportion to each category subject to the condition that there should be at least 5 members in each category. Thus, there were 6 farmers in landless, 22 in marginal, 24 in small, 28 in semi-medium, 15 in medium and 5 in large category. Primary data were collected during September-October in 2007 from the sample households on

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Milk production function: Milk production is a complex process influenced by several explanatory variables. In the present study, production function analysis was employed to estimate the resource use efficiency in milk production. The production function used was as under:

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

Where, \( Y = \) Value of milk per animal per day (Rs.)
\( X_1 = \) Expenditure on green fodder per animal per day (Rs.)
\( X_2 = \) Expenditure on dry fodder per animal per day (Rs.)
\( X_3 = \) Expenditure on concentrates per animal per day (Rs.)
\( X_4 = \) Value of labour used per animal per day (Rs.)
\( X_5 = \) Miscellaneous expenses per animal per day (Rs.)

The choice of a specific functional form depends on the economic and statistical criteria of estimated parameters and co-efficient of multiple determination \( (R^2) \).

Four types of functions i.e., Linear, Cobb-Douglas, Lin-log and Log-linear were tried in the present study. These are as follows:

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

Where, \( Y = \) output, \( X_i = \) \( i^{th} \) input used, \( a = \) constant term, \( b_i = \) partial regression coefficients to be estimated and \( u = \) random error term distributed normally with zero mean and constant variance. Production function was fitted to the data aggregated for all categories of households. Further, output (\( Y \)) and inputs (\( X_i \)) were measured in monetary values rather than physical quantities because the quality of feeds and fodder differ from one respondent to other.

Marginal value productivity (MVP): Marginal value productivity of inputs from the most appropriate milk production function i.e., Linear for buffaloes and Cobb-Douglas for crossbred cows in the present study was worked out as follows:

- **Linear**: \( \text{MVP} = b \) (in Liner production function) and \( \text{MVP} = \frac{P}{X_i} \) (in Cobb-Douglas production function). Where, \( Y \) and \( X_i \) are the geometric means of \( Y \) and \( i^{th} \) input, respectively and \( b \) is the estimated regression coefficients of \( i^{th} \) input.

Resource use efficiency: Resource use efficiency of inputs measures whether or not the inputs are used optimally. They are used optimally if the MVP of the input is equal to its price i.e., \( \text{MVP} = P_i \). Where, \( P_i = \) unit price of the input. In order to examine the resource use efficiency, the MVP of various inputs was worked out for significant estimated parameters in the estimated milk production function. Any deviation of MVP of input from its unit price may be termed as resource use efficiency. 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 an input and its unit price.

\[ t = \frac{\text{MVP}_i - P_i}{SE (\text{MVP}_i)} \]

RESULTS AND DISCUSSION

Input-output relationship: Choice and specification of variables have considerable importance on the regression analysis. Even if a single relevant variable is omitted or an unwanted variable is included, the fitted model becomes biased in the economic sense (Heady and Dhillon, 1961). In the present study, milk production function was fitted for milking buffaloes and crossbred cows using expenditure on green fodder, dry fodder, concentrates, labour and miscellaneous expenses as explanatory variables. Four production functions viz. Linear, Cobb-Douglas, Linear-log and Log-linear were tried. Linear production function for buffaloes and Cobb-Douglas production function for crossbred cows was found to be best fit keeping in view the sign and significance of regression coefficients and co-efficient of multiple determination \( (R^2) \).

The milk production function for milking buffaloes revealed that 51.70 per cent of the variation in returns from milk was explained by expenditures on green fodder, dry fodder, concentrates, labour and miscellaneous expenses (Table 1). Among the five explanatory variables included, regression coefficient of concentrates was found to be positive and significant \( ((P<0.01)) \) implying that milk production of buffaloes could be significantly increased through the efficient feeding of concentrates. However, the regression coefficients of green fodder, dry fodder and miscellaneous expenses were found to be positive and non-significant whereas the
### TABLE 1: Estimated milk production function for buffaloes

<table>
<thead>
<tr>
<th>Form of production function</th>
<th>Constant</th>
<th>Estimated parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Green fodder (X₁)</td>
</tr>
<tr>
<td>Linear</td>
<td>21.729**</td>
<td>0.119</td>
</tr>
<tr>
<td></td>
<td>(7.482)</td>
<td>(0.224)</td>
</tr>
</tbody>
</table>

R² = 0.517, N = 95, ** Significant (P < 0.01). Figures in the parentheses indicate the standard error of estimated parameters.

### TABLE 2: Estimated milk production function for crossbred cows

<table>
<thead>
<tr>
<th>Form of production function</th>
<th>Constant</th>
<th>Estimated parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Green fodder (X₁)</td>
</tr>
<tr>
<td>Cobb-Douglas</td>
<td>1.495*</td>
<td>0.167</td>
</tr>
<tr>
<td></td>
<td>(0.551)</td>
<td>(0.160)</td>
</tr>
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</table>

R² = 0.812, N = 30, * Significant (P < 0.05) and ** Significant (P < 0.01). Figures in the parentheses indicate the standard error of estimated parameters.

Regression coefficient of labour was found to be negative and non-significant in the study area. The findings were in conformity with the findings of Singh et al. (2012) who reported that milk production of buffaloes could be significantly increased through the efficient feeding of concentrates in the Varanasi district of Uttar Pradesh.

The R² of the milk production function for crossbred milking cows revealed that 81.20 per cent of the variation in returns from milk was explained by expenditures on green fodder, dry fodder, concentrates, labour and miscellaneous expenses (Table 2). Further, among the five explanatory variables included, regression coefficients of concentrates was found to be positive and significant (P < 0.01) for crossbred cows implying that milk production of crossbred could be significantly increased through the efficient feeding of concentrates. However, the regression coefficients of green fodder, dry fodder, labour and miscellaneous expenses were found to be positive and non-significant in the study area. These findings were in conformity with the findings of earlier studies conducted by Roy (1994), Sinha (1997) and Singh et al. (2007) who also observed that milk production of crossbred cows could be significantly increased by the effective feeding of concentrates.

**Resource use efficiency:** In order to examine the resource use efficiency in milk production from buffaloes and crossbred cows, the marginal value productivity (MVP) of inputs whose regression coefficients were found statistically significant in milk production function were compared with their respective unit price. To test the significance of deviation of MVP of an input from its unit price, t-statistics was used.

A significant higher MVP of an input from its unit price implies that more of that input can be used to increase the milk productivity, while a significant lower MVP of an input from its unit price implies that the input is used in excess and needs curtailment.

The present study revealed that the difference between MVP of concentrates and its unit was found to positive and significant for both milking buffaloes and crossbred cows (Table 3) which indicated that concentrates was underutilised for both buffaloes and crossbred cows in the study area. The findings for buffaloes were in conformity with the findings of Singh et al. (2012) in Varanasi district of Uttar Pradesh whereas the findings for crossbred cows were in conformity with the findings of Singh et al. (2007) in Imphal West district of Manipur and Mahajan (2010) in Ludhiana district of Punjab.

**CONCLUSIONS**

The study revealed that concentrates had positive and significant influence on milk production from both milking buffaloes and crossbred cows in the study area. It was found that for both milking buffaloes and crossbred cows concentrates was underutilized in the study area. Therefore, it is suggested that dairy farmers in WMSZ should put more efforts for efficient utilisation of concentrates to increase the milk production. The extension agencies should also take more initiative for giving technical guidance to the farmers about scientific dairy farming in general and better feeding management of milch animals with quality feeds and fodder in particular, in the area.
REFERENCES