RESOURCE-USE EFFICIENCY OF COW MILK PRODUCTION IN GARO HILLS OF MEGHALAYA

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ABSTRACT

The study aims to examine the resource-use efficiency of cow milk production in Garo Hills region of Meghalaya during 2011-2015. Following stratified random sampling technique, primary data are collected from 200 dairy farms covering 36 villages of 12 administrative blocks spread across the districts of the region. The sample comprises of 173 non-descript local cattle breed and 27 crossbred dairy units. The analytical study is conducted separately for these two groups for a comprehensive comparison. To assess the resource-use efficiency in milk production four parameters viz. roughages, concentrates, labour and miscellaneous items in monetary values are taken into consideration to design the production function in Cobb-Douglas form. The findings reveal that farms maintaining non-descript local cattle breeds are statistically inefficient; however, we find clear efficiency in crossbred group. Moreover, in the former case MVP (Marginal Value of Physical productivity) for roughages and labour are negative indicating irrational uses of these inputs while expenses on other inputs are found to be positive. In case of crossbred farms estimated production function explains as much as 80% of total variations, with multiple coefficient of determination (R² = .800) and (adjusted R² = .746). Roughages and miscellaneous expenditures show strong and positive significance on production function. The functional analysis of Crossbred farms reveals that inputs are used efficiently. MVPs of all inputs also confirm the rational use of these inputs.

Keywords: Milk Production, Resource use, Cobb-Douglas Production Function, Non-Descript Local Cattle Breed, Crossbred

INTRODUCTION

India has emerged as the largest milk producing country in the world with a record milk production of 146.31 million tonnes in 2014-2015 and dairy is playing a major role in the sustainable development of rural life in India. It is taking a new dimension in the rural life of India by shifting from low productive local cow to high productive crossbred cows. However, the milk production scenario is reverse in Garo Hills of Meghalaya.

Garo Hills of Meghalaya is being dominated by Indigenous Non-Descript Local Cattle (NDLC) breed with low productivity which is engulfing the meagre crossbred cattle population. According to livestock census 2003, crossbred cattle population was 0.76% with 3207 cattle out of 416736 indigenous cattle populations. After a decade, instead of improving, the crossbred population has reduced to 0.39% being 2242 numbers only out of 567120 Indigenous NDLC cattle (Livestock Census, 2012). In Meghalaya, the total milk production during 2007-2008 was 76.50 thousand tonnes and in all the three districts of Garo Hills (East, West and South) it was 20.05 thousand tonnes with the per capita availability of milk of about 76 g per day, as against 300ml per day (Statistical Handbook Meghalaya, 2009). During the year 2011-12, milk production of Meghalaya was only 80 thousand tonnes and per capita availability was 74 grams per day, which was far below the national average of 290 grams per day (Basic Animal Husbandry Statistics, 2013).

Profits of milk production vary among different types of milch animals as well as in different breeds. It is of immense importance for the farmers to have comparative knowledge of inputs and output of milk production for different breeds of cattle and productivity. Since majority of the farmers in Garo Hills are rearing indigenous NDLC breed (99.60%) with low productivity, they have very little knowledge about cattle rearing and also less knowledge about absolute and relative profitability for
each type of breed which seriously affects rational decision making regarding dairy farming. Keeping in view the enormous dominance of Indigenous NDLC breed over crossbreed, the present study was undertaken with the objective to analyse the resource use efficiency for NDLC and Crossbred cows in Garo Hills of Meghalaya.

MATERIALS AND METHODS

Commensurate with the objective of the study, all the three district of Garo Hills viz. South, East, and West Garo Hills of Meghalaya State was selected before the splitting and formation of the latest two more new Districts i.e., South West and North Garo Hills (2012). Data were collected during 2011 to 2013 covering the entire three districts which include twelve blocks and thirty-six villages, collected from a total number of two hundred dairy owners selected through stratified random sampling procedure with the help of pre-tested schedule by personal interview method of sampling and actual field observation.

Construction of research instrument

For this purpose a schedule was prepared containing questions and columns to record information about description of the unit, herd statistics, animal housing, feeding, breeding, milking, milk production performance, various dairy operations viz., cleaning of sheds, health care and hygiene, farm sanitation, veterinary work, daily working schedule of the unit and about the member or personnel employed and cost incurred on all these items was prepared.

Processing and analysis of data include

1. Tabular analysis
2. Conversion of different categories of cattle into Standard Animal Units (Ghule et al., 2012)
3. Conversion of women and child labour to Standard man – hour (Pandey and Singh, 2004) and
4. For computation of various economic parameters Microsoft Office Excel 2007 was used.

Statistical Techniques Employed

For computation of various economic parameters Microsoft Office Excel was used. For working out of statistical parameters and for carrying out analysis of variance of data for the production function of resource use efficiency of Cobb Douglas Production function, SPSS Version 16.0 was used.

FUNCTIONAL ANALYSIS

One of the reasons for performing the functional analysis is to provide information regarding the appropriate relationship between the inputs and output that can lead to more practical recommendations and inferences and adjustments accordingly. Such information would be useful to farmers in making rational decisions about the use of scarce resources on the farms. Therefore, commensurate with the objectives to examine the functional relationship between milk yield and different input variables regression analysis techniques was used to developed input-output relationship in order to estimate the resource use efficiency in milk production. Profit in milk production enterprise per litre of milk was calculated. The determinants of profits were studied with the help of regression analysis. Ordinary least square technique was employed to estimate the coefficient of various regression functions.

RESULTS AND DISCUSSION

Resource use efficiency of milk production

Functional analysis of multivariate analysis is an important tool, where the impact of number of variables inputs used in dairy for outputs, can be obtained. Identification of more important explanatory variable i.e. inputs, creating variation in dairy productivity have been analysed as follows:
Choice of the function

A number of production functions, such as Linear Production Function, Quadratic Production Function, Cobb Douglas Production Function, Spillman Production Function, Transcendental Production Function etc. are used for measuring the efficiency of resources use in dairy output. The Cobb Douglas production function, among these had become quite popular, which is also supported by Pandey and Kumar (1981), Balishter et al. (1985), Tripathi et al. (1996), Sharma and Singh (1993), Kumar and Singh (2004), in previous studies and is used for the purpose of this study, because of its following advantages viz.

1. Complicated computations can easily be avoided since the function takes simple linear form by taking its log.
2. The elasticity of production (bi) and marginal value of physical productivity (MVP) of each variable input is obtained from the function directly and coefficient of functions (the elasticities of production) remains constant throughout the relevant range of inputs. The sum of the elasticities for various input factors indicate the nature of return to scale.

Elasticities of production

The elasticities (bi) indicate that, the percentage increase in output to one percent change in the particular input variable with all other inputs held constant. The sum of the elasticities of production indicates the percentage by which the output would change with one percent change in the value of all the input factors. The sum of elasticities equal to one indicates constant returns to scale, whereas less than one indicates decreasing returns to scale and more than one indicates increasing returns to scale.

Production efficiency

Gross output is the function of various types of input factors such as roughages, concentrate, labour and miscellaneous. The variation in level of these inputs directly affects the gross output of milk in the districts of Garo Hills. At the farm level, the producer must decide, how to combine different quantities of production resources most profitably. In fact the farmer would use each resource in such a way that the quantity of which could be increased or decreased up to the point, where marginal cost is equal to its marginal return (MC-MR), in the range of the output curve.

Return to scale

The return to scale explains that the behaviour of the change in total return when all the inputs are changed simultaneously in the same proportion as indicated by the sum of the elasticities of production of input factor included in the production function fitted in the study. Increasing constant or decreasing return to scale are said to exist when the production elasticities is greater than one, equal to one or less than one respectively.

Marginal value of physical productivity of resources

Marginal Value of Physical Productivity of a particular resource represents the expected addition to the yield also output caused by an addition of one unit of that resource, while other inputs are constant. The marginal value of physical productivity is obtained by taking the resources (x_i) as well as gross return of milk at their geometric mean.

In this section an attempt has been made to study the production elasticities and marginal physical productivities of various input factors used in resource use efficiency of milk production in dairying of West Garo Hills district of Meghalaya.

The basic question which has been addressed in our statistical effort is to obtain an estimated production function which depicts the functional form of the relationship between output and set of inputs. The first task in this effort is to identify/choose an appropriate functional form for the production mechanism that works in our actual field. The production function should represent the reality in such a manner that it is economically meaningful suitable for the size of the workshop and the signs of the estimated parameters are conceptually acceptable, theoretically meaningful and statistically significant. Traditionally the Cobb Douglas form of the production function had been
accepted as most suitable in the field of dairy farming. Therefore, we have chosen a production function which is written in the following stochastic form:

\[ Y_i = b_0X_{i1}^{b_{i1}}X_{i2}^{b_{i2}}X_{i3}^{b_{i3}}X_{i4}^{b_{i4}}e^{ui} \]  

Where,

- \( Y \) = Total Revenue of the farm (expressed in Monetary Terms)
- \( X_{i1} \) = Cost of Roughages (expressed in Monetary Terms)
- \( X_{i2} \) = Cost of Concentrate feeds including salt (expressed in Monetary Terms)
- \( X_{i3} \) = Cost of Labour (expressed in Monetary Terms)
- \( X_{i4} \) = Cost of Miscellaneous Expenditures (expressed in Monetary Terms)

And are the parameters which are to be estimated. They actually are the elasticities of respective input.

In order to examine the resource use efficiency the Marginal Value Productivity (MVPs) of inputs for which the regression coefficients were found to be statistically significant are enumerated separately. The MVP of particular input represents the additional returns of the income (in rupees) coming with the use of an additional unit of the particular input. The MVP, for the \( i \)th input in a production function of Cobb-Douglas form is defined as

\[ MVP_i = b_i \frac{\bar{Y}}{\bar{X}} \]

Where, \( \bar{Y} \) and \( \bar{X} \) are the geometric means of output \( Y \) and \( i \)th input i.e., Roughages, and \( b_i \) be the regression coefficient associated with this particular input.

For profit maximization resource use efficiency exists if inputs are used in right proportion. In literature the necessary condition for efficient use of input is described as the use of an input to the extent such that its MVP is equal to its price. If there is any deviation of MVP of any input from its unit price the situation will be referred as inefficient use of resource. The higher the difference between MVP and the price, the higher is the degree of inefficiency. Mathematically, efficiency in resource use can thus be described as

\[ MVP_i = P_i \]

Where, \( P_i \) is the price per unit of the \( i \)th input i.e., Roughages.

Now, our task is to work out the MVPs for each of the inputs for which regression coefficients are statistically significant in our estimation. For this \( t \)-statistics is used to test the statistical significance between the MVP of an input and its price. The \( t \)-statistics for this purpose is obtained as

\[ t-value = \frac{MVP_i - P_i}{SE(MVP)} \]

For Cobb-Douglas production function the Standard Error: SE (MVP) is given by

\[ SE(MVP) = SE(b_i) \frac{\bar{Y}}{\bar{X}} \]

Where, \( \bar{Y} \) and \( \bar{X} \) are the geometric means of output \( Y \) and \( i \)th input, and parameters estimated are either \( b_i \)s i.e., the regression coefficient associated with the particular input.
Table 1. Functional analysis of production with their standard errors, regression co-efficient and marginal value of physical productivity of non-descript local cattle breed and crossbred

<table>
<thead>
<tr>
<th>Variables</th>
<th>Non-Descript Local Cattle Breed</th>
<th>Crossbreed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regression Co-efficient (bi)</td>
<td>t-Ratio</td>
</tr>
<tr>
<td>Roughages (X₁)</td>
<td>-0.042</td>
<td>0.435</td>
</tr>
<tr>
<td></td>
<td>(0.096)</td>
<td></td>
</tr>
<tr>
<td>Concentrates &amp; Salt (X²)</td>
<td>0.006</td>
<td>0.841</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td></td>
</tr>
<tr>
<td>Labour (X³)</td>
<td>-0.058</td>
<td>1.031</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Expenditures (X⁴)</td>
<td>0.38*</td>
<td>2.114</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>173</td>
<td></td>
</tr>
<tr>
<td>Sum of elasticities</td>
<td>0.286</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.036</td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.013</td>
<td></td>
</tr>
<tr>
<td>t-Ratio (Constant)</td>
<td>6.755</td>
<td></td>
</tr>
</tbody>
</table>

Note: Figures in parenthesis indicates standard error of corresponding elasticities.
* Denotes significant at 0.01 percent level of probability.
** Denotes significant at 0.05 percent level of probability.
*** Denotes significant at 0.10 percent level of probability.

Non-Descript Local Breed→ \( Y = X_1^{0.042} X_2^{0.006} X_3^{-0.058} X_4^{0.38} \)
Crossbred→ \( Y = X_1^{0.498} X_2^{0.06} X_3^{0.101} X_4^{0.291} \)

The above table indicate that the regression of the Cobb Douglas production function for Non-Descript Local Cattle Breed is statistically insignificant as it is reflected by the value of \( R^2 \) (0.036) and adjusted \( R^2 \) (0.013). Hence, the standard econometric model with Cobb Douglas form of production function cannot give any significant result.

The statistical results of the estimation of production function for 20 cross breed farms are exhibited in the same table. The multiple \( R^2 \) and adjusted \( R^2 \) are found to be 0.800 and 0.746 respectively which indicate that all the controllable inputs namely roughages, concentrate feeds, labour and miscellaneous expenses explain 80 percent variation in milk production. Roughages and variety expenses showed strong, positive and significant impact on production function. More precisely, one percent increase in roughages will result an increase of about 0.498 percent of output when other inputs remain unchanged. Similarly in case of Concentrate Feed the respective increase in milk production is 0.06 percent.
production is merely 0.060 per cent; for Labour 0.101 per cent however, for miscellaneous expenditure 0.291 per cent when all other controllable inputs are kept constant.

The Marginal Value of Physical Productivity (M.V.P) for the different production resources used in Non-Descript Local Cattle Breed and Crossbred under study have been presented in table 30 along with functional analysis of production with their standard errors and regression co-efficient. It is evident from the above table that the investment on miscellaneous expenditures provides highest return (0.494) followed by cost of concentrates and salt (0.019), where as it was negative for roughages (-0.044) and labour (-0.055) for Non-Descript Local Cattle Breed which clearly indicated the irrational use of these input factors. For Crossbred, the investment on roughages and miscellaneous expenditures provide highest return of 0.595 and 0.378 respectively followed by `0.124 for labour and `0.071 for concentrates.

However, after working out the marginal value of physical productivity (M.V.P) of both the categories of cows, the regression co-efficient of each of the variables are found to be less than one for the two categories of cows showing diminishing return to scale as shown earlier. However, the regression coefficient shows that the estimated percentages of miscellaneous expenditures (x4) for Non-Descript Local Cattle Breed is significant at 0.01 per cent level of probability and for Crossbred roughages and miscellaneous expenditures were found to be significant at 0.05 and 0.10 per cent level of probability respectively.

The functional analysis of Non-Descript Local Cattle Breed revealed that variables like roughages, concentrates, labour and miscellaneous items were used on inefficient line and marginal value of physical productivity (M.V.P) of roughages and labour were also negative indicating irrational use these inputs by the farmer but investment on other variable like concentrate and salt and also miscellaneous expenditure observed as positive indicating rational use of these input by the farmers in the area. Same way the functional analysis of Crossbred revealed that inputs like roughages, concentrates, labour and miscellaneous expenditures were used on efficient line and the marginal value of physical productivity (M.V.P) of all inputs also positively indicating rational use of these inputs by the farmers in the study area. Keeping in view the high maintenance and working cost of the input factors such as roughages, concentrates, labour and miscellaneous expenditures on Non-Descript Local Cattle Breed, which indicates lack of knowledge among the farmers to use this input factor. This suggest proper training in management, maintenance and rational use of the input factors among the farmer as this may increase production and productivity of milk in the study area.

A good number of research workers have come out with different conclusions in respect of their studies on resource use efficiency using milk production function analysis revealing that green fodder and concentrate affect milk yield significantly. Further MVP of these inputs indicated that the milk productivity of milch cows could be increase through feeding of higher level of these inputs effectively (Wani et al., 1992, Rajendra and Prabhakaran, 1993, Chandra, 1998). Kumar and Singh’s findings in 2004 explained 72 and 70 per cent of variation in returns from milk yield of local and crossbred cows respectively.

Similar works have been done by Carley in 1979 but he analysed and found capital investment, labour time forage system were not significantly related to production costs, the variables used were, therefore, number of milking cows, milk production per cow, milk concentrate ratio and capital investment per cow. There was 46% of the variation in production costs of milk production. Cow was the most important single variable accounting for 31 per cent of variation with a 10 percent change in production per cow unit. Increase in herd size by 10 per cent decreased unit cost by 1 percent the effect of increasing herd size was greatest with smaller herds (50-100 cows) and lower production per cow. Whereas no significant estimates of the above parameters were found for local milking cows in Imphal West district of Manipur, India, by Singh at et. (2007). In another study conducted by Sharma et al. (2014) revealed that partial regression coefficients of expenditure on concentrates and green fodder were found to be positive and significant for all types of dairy cattle. The production function analysis indicated that milk production can be increased through effective feeding of concentrates and green fodder for all kinds of dairy animals. Their observed results further revealed that the partial regression coefficients for dry fodder, labour and miscellaneous expenses were not significant with
variable signs which resulted in no further interpretation. The $R^2$ for local cow, cross bred cow and buffalo were observed to be 0.52, 0.82 and 0.70, respectively. They concluded that the resource-use efficiency of green fodder for all types of dairy animal was found negative, which indicated that the inputs (green fodder) were over-utilized and concentrates in case of local cow were under-utilized, while they were over-utilized in case of buffaloes and optimally used in case of crossbred cattle.

**CONCLUSION**

The econometric analysis of the production function for NDLC failed to establish efficiency in resource-use. A number of socio-economic as well as ethnicity-based realities perhaps plays crucial role behind this. The dominant reason could be the fact that the farmers rear cattle as part of their lifestyle, the profit, earned from milk production, hardly get any priority. As the main occupation of these cattle-keepers is agriculture the benefits from cattle is judged from agrarian point – they are helpful for ploughing, for the supply of organic manure, also as carrier during harvest. Moreover, cattle can be considered as a source of monetary resources during death, birth, marriage, social gatherings and other festive occasions.

Our present data set has perhaps been unable to capture the accurate production/profit function with which several untraceable considerations are involved. There may exist a number of factors for the insignificant coefficients of resource-use. First the dairy units are scattered in different parts of Garo Hills Region – mainly in two districts namely East and West Garo Hills. These areas have wide variations in terms of agro-climatic, socio-economic, geo-political considerations. Moreover, the markets for both inputs and dairy products are heavily imperfect in economic sense. In addition, due to significant location differences, the behavioural aspects of the market had been significantly different. Hence, the geometric means for both inputs and output are not only robust and volatile; they fail to indicate any theoretical significance for resource use.

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