International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 22s, 2025
https://theaspd.com/index.php

Production Behavior of the Dairy Sector in Assam with Special Reference to Golaghat District

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Abstract: *The dairy sector plays a pivotal role in India's agrarian economy, providing income, employment, and nutrition to millions, particularly in rural areas. Assam, with its predominantly smallholder and subsistence-oriented dairy farms, contributes significantly to the state's rural livelihood and food security. This study examines the production behaviour of the dairy sector in Golaghat district of Assam, focusing on resource-use efficiency, factor productivity, and returns to scale. Using both primary and secondary data, a multistage sampling farmers was conducted, and production functions were estimated through the Cobb-Douglas model. The results reveal that labour and land are the most significant determinants of dairy output, while capital plays a comparatively minor role. Findings also highlight structural constraints such as limited capital investment, inadequate veterinary support, and dependence on traditional practices, which restrict productivity gains. The study concludes that improving efficiency and productivity requires policy interventions in cooperative development, feed and healthcare facilities, and better integration with formal milk markets.*

Keywords: *Dairy Sector, Production, Behaviour, Production Function, Agriculture.*

1. INTRODUCTION:

The dairy sector plays an important role in the Indian economy. The Indian economy is agriculture-based, and the dairy sector falls under agriculture allied sector. It significantly contributes to the national income and creates employment opportunities for millions of rural poor. The dairy sector also provides nutritious foods to the people. Most of the rural households engage in the dairy sector and earn their livelihood. The dairy sector creates employment opportunities for the weaker section of society, including landless farmers, marginal and agricultural labourers. In India, dairy farming is largely a subsistence-level activity because the dairy farmers mostly use the indigenous cows and traditional technology due to a lack of capital. They use locally available resources. The dairy sector contributes a handsome amount to the national income. The role of Agriculture is very important in the Indian Economy, and it contributes 17% to the national income in the financial year 2022-23. The livestock sector, including dairy, has a 24% share in total agricultural output.

The dairy sector in Assam is a crucial component of the rural economy, contributing significantly to employment, livelihood, and growth. This paper examines dairy farms' production behaviour and efficiency in Assam, and analyses various determinants of productivity and also tries to identify the areas where improvements can be made. The informal milk sector constitutes about 95% of the market in Assam, and it is characterised by rural smallholder and subsistence production systems. There is a clear indication that the development of the traditional market is significant for the Assam dairy sector as it transitions to a more formal way of operating. In dairy production, the Cobb-Douglas production function can provide valuable insights. A study on dairy production in Boyolali Regency utilised multiple linear regressions with the Cobb-Douglas model to determine influential factors in the production process. Such a study typically aims to identify and quantify the impact of inputs like feed, labour, and Capital on the quantity of output. This approach is crucial for understanding how to optimise production and increase efficiency within the dairy sector. The main importance of this paper lies in understanding that dairy farmers can potentially apply this model to analyse and improve their production processes. It is essential to comprehensively analyse the factors influencing the dairy milk production function. In this paper, an attempt has been made to analyse the labour and capital structure and ratios and their relative contribution to production and productivity. After analysing the factor ratios, a meaningful production function is also attempted to construct, along with returns to scale, total factor productivity and efficiency of inputs.

2. REVIEW OF LITERATURE:

The concept production function represents the relationship between input resources and outputs, and it provides a framework to assess productivity and technological progress. In the context of dairy farms, it encompasses factors like labour, land, Capital, and intermediate goods such as feed and veterinary services. Through an empirical analysis of data collected from dairy farms in the Golaghat district of Assam, this study provides insights into the resource-use patterns, adoption of technologies, and the socio-economic factors affecting the efficiency of dairy production.

India's position is at the top among the milk producers of the world, and it plays a specific role in the agriculture sector. Studies like Kumar et al. (2011) have analysed the production function of dairy farms across different regions, indicating a diverse range of practices and productivity levels. Research by Patel and Mehta (2015) further highlighted the importance of capital investments in increasing milk yield and suggested that larger farms tend to benefit from economies of scale.

Based on the research and studies conducted by various organisations and researchers, the production behaviour and efficiency in the dairy sector of Assam have been the subject of considerable attention due to the sector's potential for growth and its socio-economic impact. Focusing on Assam, the literature reflects unique local practices and constraints. Choudhury and Saikia (2017) provided an in-depth analysis of the production functions of dairy farms in Assam, noting that the majority operate on a small scale with limited capital inputs. The research indicated a strong reliance on family labour and traditional farming methods. The literature consistently points to constraints such as inadequate veterinary healthcare, poor quality feed, and lack of proper marketing channels as significant impediments to optimising the production function. However, opportunities for improvement are also recognised. For instance, Goswami (2021) suggested ample scope for enhancing production through cooperative models and better market integration.

3. OBJECTIVES OF THE STUDY:

The main objectives of the study are to:

i. To analyse the farm's capital and labour ratio and its relationship with Farm size.
ii. To analyse dairy farms' production behaviour and returns to scale in the study area.
iii. To find out the production efficiency of dairy farms in the study area.

4. METHODOLOGY:

The location of the study is the Golaghat District of Assam, and the populations are the dairy farmers of the Golaghat District of Assam. The collected dataset is generally classified into primary and secondary data. This study is based on both primary and secondary data. The primary data were collected by undertaking a field study to investigate the production and productivity of milk farms in the Golaghat district of Assam. The sample survey was conducted following multistage sampling (Random sampling) for the present study. The multistage sampling technique involves several methods of random sampling. There are eight Development blocks in Golaghat district, and in this study 50% of the Development blocks of the district were selected initially. In the 2nd stage, about 50 numbers of Dairy farmers were selected from each Development Block. There was one schedule prepared for collecting primary data from household-level dairy farmers. Information on the general and production methods and other details was collected by interviewing the household owner, whose primary occupation is dairy farming. Thus, a total of 200 farmers were selected for the study.

An attempt has been made to estimate plausible and meaningful production functions for the Dairy Farms. Before deciding the production behaviour of the Dairy Farms, it is necessary to estimate the elasticity of substitution (σ) as it determines the process of labour absorption in the production process in the developing countries.

The general form of the Cobb-Douglas production Function is

$Q = AL^{\alpha} K^{\beta}$ ..... (1) $[L > 0, K > 0, \alpha > 0, \beta > 0, \alpha + \beta = 1]$

Where,

Q is the total production (Output).

L and K represent labour and capital inputs.

α and β are the output elasticity of labour and Capital, respectively.

A is Total Factor Productivity.

Given the data, the parameters α, β, and A are estimated using regression techniques, typically a log-linear regression since the Cobb-Douglas function is often expressed in a logarithmic form.

Then α and β are the output elasticity concerning labour and Capital, respectively. The form mentioned above of the Cobb-Douglas production function is non-linear, but it can be transformed to linear by taking the log form of the function as follows:

Log Q = log A+ α log L+ β log K.....(2)

Zero/Mission values in the data become undefined when transformed into logarithms, and those input values are removed.

Return to Scale:

Several vital economic measures can be calculated in the Cobb-Douglas (CD) production function, including Returns to Scale, Total Factor Productivity, and Marginal Productivity of factors. Returns to Scale (RTS) in a Cobb-Douglas production function are determined by the sum of the exponents of the inputs (commonly labour and Capital, but can include others like land).

If α+ β> 1, the production function exhibits increasing Returns to Scale. This means that if all inputs are increased by a certain percentage, total output increases by a more significant percentage.

If α + β= 1, it exhibits Constant Returns to Scale. Thus, increasing all inputs by a certain percentage leads to an equal percentage increase in output.

If α + β< 1, it exhibits decreasing returns to scale. In this case, increasing all inputs by a certain percentage leads to a smaller percentage increase in output.

Total Factor Productivity (TFP):

Total Factor Productivity represents the efficiency with which all inputs are transformed into output. It's often associated with technological progress, efficiency improvements, or changes in organisational structure. In the CD function, A is considered the TFP.

$$A = \frac{Q}{K^{\beta}L^{\alpha}}$$

Total Factor Productivity captures factors affecting production that aren't directly accounted for by the measured inputs. A higher TFP indicates more output is being produced from the given inputs, reflecting better technology or efficiency. These measures are fundamental in economic analysis, helping farms, economists, and policymakers understand and improve production processes. They provide insights into efficiency, resource allocation, and potential areas for technological improvement or investment.

5. RESULT AND DISCUSSION:

5.1. Estimation of the CD Production Function:

The primary aim of this study section is to deduce an appropriate production function for Dairy Farms to facilitate further practical analysis. Before identifying the production dynamics of Dairy Farms, it's essential first to calculate the elasticity of substitution (σ), which influences labour integration in the production mechanism. In the widely utilised Cobb-Douglas (C-D) production function, this elasticity between labour and Capital is uniformly one. Conversely, in the Constant Elasticity of Substitution (CES) production function, σ remains constant, treating the C-D and Leontief Production Functions as particular instances. Consequently, σ is a crucial parameter in determining the appropriate production function model for the SSIs' production activities. The fitted CD production function is:

Log Q = log A+ α log L+ β log K

Table 4: Result of Production Function:

Q	A	L	K
Coefficient Values	1.9671	0.1768	0.0337
t	18.771*	6.813*	1.229

R^2= 0.611 $\bar{R}^2$= 0.603 F = 26.20*

* Statistically significant, as indicated by the p-value (95% confidence interval)

Since Capital looks insignificant, land is used in the model, and the model is reconstructed as:

$Q = AL^{\alpha} K^{\beta} N^{\gamma}$

Where:

Y is the total production (the real value of all goods produced in a year or output).

L, K, and N are the inputs for labour, Capital, and a third input, which in this case could be land.

A is the total factor productivity.

α, β, and γ are the output elasticity of labour, Capital, and land, respectively.

Elasticity measures the percentage change in output resulting from a percentage change in inputs. In a log-linear form, this model becomes linear, making it easier to estimate the parameters using linear regression. The log-linear form is:

$\text{Log } Q = \log A + \alpha \log L + \beta \log K + \gamma \log L_x$

Where Q is the dependent variable, and L, K, and L_x are the independent variables.

Table 1: Result of Production Function:

Q	A	L	K	L_x
Coefficient Values	0.401	0.172	0.016	0.350
t	2.65*	1.54*	0.15	3.20*

$R^2 = 0.932$ $\quad \bar{R}^2 = 0.931$ $\quad F = 9.7$ *

* Statistically significant, as indicated by the p-value (95% confidence interval)

Returns to Scale: The returns to scale are approximately 0.538. Since this is less than 1, it indicates decreasing returns to scale. This means that as all inputs increase by a certain percentage, the output increases by a smaller percentage. These results provide a comprehensive understanding of how well the model fits the data and the significance of each input. They also offer insights into the production process's nature in terms of returns to scale.

5.2. Total Factor Productivity:

The average Total Factor Productivity (TFP) across the filtered dataset is approximately 1.502. This value represents the efficiency with which the inputs are transformed into output, factoring in the effects of technology, efficiency improvements, and other factors not directly accounted for by labour, Capital, and land. In the context of the Cobb-Douglas production function, the Marginal Product of Labour (MPL) and the Marginal Product of Capital (MPK) are 0.9192and 0.021. This indicates that, on average, an additional unit of Capital will increase the output by about 0.021 units, holding other factors constant. The average Marginal Product of Land is approximately 0.0598. This indicates that, on average, an additional unit of land will increase the output by about 0.0598 units, holding other factors constant. This information can be beneficial for understanding how changes in land usage might impact overall production, helping in decision-making regarding resource allocation or investment in land.

6. Findings:

6.1. Initial analysis with the Cobb-Douglas production function yielded the following: The coefficients for labour and Capital were found to be 0.0337 and 0.1768, respectively, with log Q having a coefficient of 1.9671. The t-values for these coefficients were significant, particularly for log Q and log A.

6.2. The R^2 value of 0.611 indicates that around 61.1% of the variance in output is explained by the model. However, the relatively lower significance of Capital led to a reconsideration of the inputs.

6.3. Revised Production Function with Land: The model was extended to include land as an additional input, leading to the function. Significant changes were observed in the coefficient values and their significance levels. The coefficients for labour and land showed significant t-values, indicating their importance in the production function. The R^2 value increased dramatically to 0.932, indicating a much better fit with the inclusion of land.

6.4. The returns to scale were calculated to be approximately 0.538, suggesting decreasing returns to scale. This means that as all inputs increase proportionally, the output increases, but at a diminishing rate.

6.5. The study calculated an average TFP of about 1.502 across the dataset, reflecting the efficiency of input transformation into output, considering technological and efficiency improvements.

7. CONCLUSION:

The study effectively deduced production functions for Dairy Farms, initially using a Cobb-Douglas approach and then moving to a more comprehensive model including labour, Capital, and land. The inclusion of land significantly improved the model's explanatory power and highlighted the varying impacts of different inputs on production. The DEA analysis provided valuable insights into how farm size affects operational efficiency, with smaller farms generally outperforming larger ones in efficiency scores. These findings offer a nuanced understanding of the production dynamics in Dairy Farms and can guide future operational and investment decisions, particularly in the context of resource allocation and process optimisation. The above analysis on the production function of dairy farms in India, with a particular focus on Assam, indicates a sector with significant variability in practices and efficiencies. While considerable challenges exist, the potential for improvement through technological adoption, policy

intervention, and socioeconomic development is evident. This sets the stage for this study to delve deeper into the production and marketing structures specific to Golaghat District in Assam, contributing to the academic discourse and providing actionable insights for stakeholders.

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