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Farm Level Technical Efficiency of Dairy Farms: A Study in Barpeta and Morigaon Districts of Assam.

Md. Abu Jafor
Asst. Professor, South Salmara College, South Salmara, Assam, India
Corresponding Author: Md. Abu Jafor

Abstract: To resolve the overall food, health and education problems occurring in the world today, international development goals were set that are directly or indirectly associated with livestock sector even more to dairy farming (DFID, 2005). India is endowed with the largest livestock population in the world. Thus, there is a tremendous potential for increasing the milk production through profitable dairy farming. This is possible only by utilizing efficient use of available resources and technology. In an economic and social point of view, increasing the efficiency level in milk production is a highly important area of Indian agriculture and Assam as well. With these backdrops, the present study aims to measure the farm level technical efficiency of the dairy farmers in select two districts of Assam. A total of 278 farm household were selected from eight dairy dominated villages of Barpeta and Morigaon district of Assam. The present study was conducted to determine the level of technical efficiency of dairy farms in Assam by applying Stochastic Production Frontier (SPF) methodology. Findings of the study revealed that there exists ways to improve farm level technical efficiency with the existing level of inputs and modern techniques. To enhance farm level technical efficiency there is a need to educate the farmers so as to cope up the farmers to adopt new technology.

Keywords: technical efficiency, farm level, stochastic production frontier, dairy farmer, Assam.

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I. INTRODUCTION:

To resolve the overall food, health and education problems occurring in the world today, international development goals were set that are directly or indirectly associated with livestock sector even more to dairy farming (DFID, 2005). As income increases with economic development, the share of animal products in total food budget increases faster than that of cereals, the elasticity of demand for livestock products is three to five times higher than that of cereals (FAO**).**

India is endowed with the largest livestock population in the world. It accounts for about 57.3 per cent of the world's buffalo population and 14.7 per cent of the cattle population. Thus, there is a tremendous potential for increasing the milk production through profitable dairy farming. This is possible only by efficient allocation of resource use. Although in Assam, around eighty per cent of the rural households keep cattle, but milk productivity is very low in the state i.e. .annual growth of milk production in the state is much lower than that of national average. In India milk production has increased from 17 million tons in 1950-51 to 155.50 tons in 2015-16. Accordingly, per capita availability also increased from 130 gram/day to 337 gram/day during the same period. While in Assam milk production has increased from 822 million liters in 2005-06 to 888 million liters in 2015-16. Accordingly, per capita availability also increased from 69 gram/day to 71 gram/day during the same period. The gap in per capita availability and nutritional requirement as well as population base demand projection, milk production in Assam leaves a huge gap with actual demand.

Milk and milk products play an important role in human nutrition, thus milk production is an important issue in the global food supply chain, particularly in developing countries and more especially in Assam. Based on these, in terms of the global nutrition supply, it is important to increase milk production efficiency in the future to meet the enormous dairy product demand of explosive population growth. The question of efficiency should be a priority area for the dairy farms to ensure that a single dairy farm can also produce competitively and efficiently for the national and global markets in an economically, socially and ecologically sustainable way.

II. DATA SOURCE

The present study was based mainly on primary data. The information required for this study was collected from the primary source. The data used in this study was collected through personal interview with dairy farmers included in the sample. A semi-structured questionnaire was designed to obtain information from the respondents regarding the socio-economic and farmer characteristics to be answered in the interview. All the data collected for the study pertains the year 2017-2018. The respondent household was selected from two development blocks located in the two districts Viz- Barpeta and Morigaon of Assam. These districts were selected purposively since the area had a significant dairy activity. In order to select the district, multistage sampling procedure was applied and the sample household was determined by using Cochram formula (1963:75). A total of 278 sample dairy farming household were selected from eight villages for collecting the required information for the study.

The data set supplies information on various inputs such as feed, labor and capital, number of lactating cows, milk production for each cow. General information on household characteristics such as age, gender, education, contact with extension, experience, membership in dairy cooperative, credit received by the farmer was recorded at the time of interview. The time period for the study is one single year. The study areas were selected because they have significant dairy activity and are the major sources of liquid milk supply to the processor as well as to the urban consumers in the capital of the state.

III. NECESSITY OF THE STUDY

Efficiency of dairy farms has been investigated in many studies which include Fraser and Cordina (1992), Mbaga et.al (2002), Dalton (2004). Efficiency measurement has received considerable attention from both theoretical and applied economists. The measurement of efficiency is an important issue because it gives pertinent information for making sound management decision in resource allocation.

Milk is a vital source of nutrition, is the main nutrient for human beings. The basic way to increase milk supply is to improve productivity and efficiency in cow milk production. Thus measuring efficiency is important to increase farm level efficiency. This is possible only by making efficient allocation of scarce resources.

IV. METHODOLOGY

Concept of efficiency:

The terms productivity and efficiency are often used interchangeably but they are not precisely the same things. Productivity is an absolute concept and is measured by the ratio of outputs to inputs while efficiency is a relative concept and is measured by comparing the actual ratio of outputs to inputs with the optimal ratio of outputs to inputs.

Efficiency of dairy farms has been investigated in many studies. Recent reliable studies which investigated dairy production in both developed and developing countries include Fraser and Coridna (1999) Mlaga et al. (2002) Dalton (2004).

The measurement of economic efficiency has been intimately linked to the use of frontier functions. The modern literature in both fields begins with the same seminal paper, namely Farrell (1957). Michael J. Farrell, greatly influenced by Koopmans (1951)'s formal definition and Debreu (1951)'s measure of technical efficiency introduced a method to decompose the overall efficiency of a production unit into its technical and allocative components. Farrell characterized the different ways in which a productive unit can be inefficient either by obtaining less than the maximum output available from a determined group of inputs (technically inefficient) or by not purchasing the best package of inputs given their prices and marginal productivities (allocatively inefficient).

Technical Efficiency refers to the achievement of the maximum potential output from given sets of inputs, taking into account the underlying production function. In economic theory, a production function is described in terms of maximum output that can be produced from a specified set of inputs, given the existing technology available to the firm (Battese, 1992).

Farrell (1957) proposed that the efficiency of a farm consists of two components: technical efficiency, which reflects the ability of a farm to obtain maximum output from a given set of inputs and allocative efficiency, which reflects the ability of a farm to use the inputs in an optimal proportions, given their respective prices and the production technology. These two measures combined to provide a measure of economic efficiency.

Battese and Coelli (1995) also proposed a stochastic frontier production function for panel data in which technical inefficiency effects are specified in terms of explanatory variables, including a time trend to take into account changes in efficiency over time.

Efficiency analysis in milk production become all the more important in a developing countries like India which are basically low input and low output environments characterized by subsistence holding, resource

poor locations with milch animals of low production potential and having poor infrastructural support system.(Bardhan D)

Institutional factors, Socioeconomic and farm characteristics have significant effects on the level of technical efficiency (TE) and allocative efficiency (AE). To determine the level of TE of dairy producing farms in Jordan Al-Sharafat (2013) has applied the stochastic production frontier methodology. The results show that farmer's level of education, farmer's farming experience, farmer's contact with an extension service and herd size are the main determinants associated with TE. Using the stochastic production frontier function approach, Surender and Sharma (2012) investigated the Technical efficiency of small dairy farmers in India and found that building the supply chain can increase the efficiency of dairy farmers, as the milk producers who are part of a cooperative supply chain experienced a higher technical efficiency as compared to those who do not follow the modern supply chain practices.

Khan et al. (1999) in Peshawar valley in Pakistan measured the technical efficiency of dairy farms. The estimated inefficiency is explained by socioeconomic and demographic factors of dairy farmers. Family labor, education, credit and experience in dairy farming contribute positively towards improvement of efficiency.

Using the stochastic production frontier (Majiwa, Kavoi and Murage 2012) examined the technical efficiency of small holder dairy farms of rural Kenya. This study reveals that land size, access to extension service, feed, infrastructure and the level of schooling reduce inefficiency.

Using the stochastic frontier analysis (Kimenchu et.al 2014) evaluated the technical efficiency of 135 dairy cow farms in Embu and Meru countries of Kenya.. This study revealed that the number of lactating cows and the amount of roughages, concentrates and mineral supplements were the major factors influencing milk output.

Using stochastic production frontier (Kumbhakar, Biswas and Bailey 2015) investigates the technical, allocative and scale inefficiency of owner operating dairy farms in Utah. The study indicates that there is a positive association between farmer education and productive efficiency. The empirical findings also indicate that productivity is negatively related to off farm income

Using stochastic frontier production function analysis (Umamegeswari, Dixit and Sivaram 2016) was conducted a study in Coimbatore and Tirupur districts of Tamil Nadu state of India with the objective of estimating technical efficiency of milk production with respect to different milch animals. The education level of famers had the positive impact on returns from milk production of crossbred cows while age negatively and significantly influenced the technical efficiency in crossbred and local cow farms; land holding size had the negative and significant influence. In case of the herd size it was found that the estimates for local cows were negative and significant.

Adiel P. M (2015) analyzed technical efficiency of smallholder dairy farmers in EPINAV dairy project in Tanzania. Experience of the dairy farmer negatively influenced inefficiency at 5% level of significance. Education level, farm records, economic status and number of extension visit showed expected signs despite of being insignificant.

Peternus M. M (2013) conducted a study in nine dairy cattle keeping villages of Njombe District Council (NDC) with the overall objective of estimating Technical Efficiency (TE) and analyzing factors influencing Technical Inefficiency (TI) of smallholder dairy farmers. This study revealed that age, gender, education level, experience of the farmer and selling to processor are major factors having a significant and positive influence on the farmers' technical inefficiency while marital status and use of hired labor are the major factors having a significant and negative influence on the farmers' technical inefficiency.

The level of technical efficiency of a particular farmer/firm is characterized by the relationship between observed production and some ideal or potential production (Greene, 1993), often measured as a ratio between the output of a particular farmer/firm and the maximum possible output obtainable (frontier) using a given set of inputs under a given technology.

V. RESULTS AND ANALYSIS:

The results of farm level technical efficiency was obtained by using frontier version 4.1 and shown in the following table. From the table it is seen that all the seven explanatory variables are significant.

Maximum Likelihood Estimate (MLE) of the Stochastic Frontier Production Function:

Variables	Parameter estimate	Coefficients	t ratio
Intercept	β_0	3.993	8.158***
Concentrate feed	β_1	0.154	2.488**
Food supplement	β_2	0.516	5.345***
Veterinary cost	β_3	0.098	2.181**
Hours spent on Dairy	β_4	0.143	2.216**

No. of Lactating cows	β_5	0.815	7.847***
Education level	B_6	-0.48	-1.98**
Dairy experience	B_7	0.29	2.43**
Sigma square	σ2	0.119	5.893***
Gamma	γ	0.759	7.596***
Log Likelihood function	λ	-0.3.852	
LR test of the one- side error		4.978	

Significant *** at 1% and ** at 5% respectively.

Calculated by the Author based on primary data 2017-2018.

The sigma squared (σ^2) with value of 0.0119 is statistically significant and different from zero at $\alpha = 0.01$. This indicates a good fit and the correctness of the distributional form assumed for the composite error term. The estimated gamma parameter (γ) of frontier model is 0.759 and significant ($P < 0.01$), indicates that systematic influences that are unexplained by the production function are the dominant sources of random error. This means that 75.9% of the variation in output among the dairy farmers was due to disparities in technical efficiency.

The results in the Table shows that the coefficient of food supplement and the number of lactating cows is found positive and significant at 1 per cent level of significance which indicates that one per cent increase in food supplement and herd size(no. of milking cows), milk production will increase by 0.516 and 0.815 per cent respectively. Similarly, the coefficient of purchased concentrated feed, hours spent by family labor and veterinary cost has come out to be positive and significant at 5 per cent level of significance which indicates that one per cent increase in the use of purchased feed, hours spent by family labor and veterinary cost, milk production will increase by 0.154, 0.143 and 0.098 per cent respectively. Finally, the coefficient level of education and dairy experience had significant at 5 per cent level of significance. However the coefficient education is showing a negative sign which implies that educational attainment of the farmer reduces inefficiency. The mean technical efficiency for the farmers is 79.84 per cent.

VI. CONCLUSION AND SUGGESTION:

It is a well-known fact that efficient farms are more likely to generate higher incomes and thus stand a better chance of surviving and prospering. The study indicated that most of the dairy farmers in the study area are technically efficient. However, there exist systematic in efficiency in milk production. The average technical efficiency level of the farmers is only 79% implying that milk production can be increased on an average by 21% with the existing technology by training of dairy farmers, better production techniques. Technical efficiency can be further improved through provision of education as education variable is positive and significant at 1 per cent level of significance which indicates that education is crucial for increasing technical efficiency.

The study focused on dairy farmers in BAJALI and MAYANG (Sitajakhala) Milk Shed Area alone. There is need for a further study to be conducted in all regions of the state to capture variation in economic efficiency in different regions of the state. This will assist in prioritizing expansion of dairy development efforts.

Again, this study measures only technical efficiency of the dairy farmers and factors influencing technical efficiency. Thus this study opens up windows for further research to analyze allocative efficiency of the dairy farmers along with its determining factors.

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