ECONOMIC EFFICIENCY OF MILK PRODUCTION IN DISTRICT PESHAWER: A STOCHASTIC FRONTIER APPROACH

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ABSTRACT

This study examines the economic efficiency of milk production in district Peshawar during 2009 with a view to examine the productive efficiency of milk. Data were collected from 100 farmers selected by using multi-stage sampling technique and analyzed using descriptive statistics, stochastic frontier production and cost function models. The return to scale (RTS) for the production function revealed that the farmers operated in the irrational zone (stage I) of the production surface having RTS of 1.074. The result of the analysis indicate that presence of technical inefficiency and allocative inefficiency had effects in milk production as depicted by the significant estimated gamma coefficient of each model, the generalized likelihood ratio test and the predicted technical and allocative efficiencies within the farmers. The estimated gamma parameter (γ) for production function was 0.851, indicating that about 85% of the variation in the output of milk among the farmers was due to differences in their technical efficiencies while the estimated gamma parameter (γ) of model for the cost function was 0.781 indicating that about 78% of the variation in the total cost of production among the farmers was due to the presence of allocative inefficiency. The result also show that rising age would lead to a decline in the efficiency means, and recommended that Government policy should focus on ways to attract and encourage young people who are agile and aggressive in Dairy business.

Key Words: Efficiency, Economic, technical efficiency, Stochastic frontier function.

INTRODUCTION

Livestock plays an important role in the economy of our country and the livelihood of people. Livestock accounts for 52.2% of agriculture value added and 10.9% of national GDP. It is a net source of foreign exchange earnings, constituting more than 8.5% of the total exports. It is an important source of raw material particularly for leather, carpet and woolen cloth industries. Livestock is raised by more than 8.5 million small and landless families in the rural areas and is their main livelihood source. It is a form of social security for the poor, who cash it at the time of need and it also serves as security against crop failure in barani (rain-fed) areas (GOP, 2007).

Dairy sector is an important component of Pakistan’s economy. Within the livestock sector, milk, eggs and beef account for 72%, 20%, and 2.7% of the value of output respectively whereas, the remaining 5.3% goes to other products (GOP, 2007). The value of milk alone exceeds the combined value of wheat, rice, maize and sugarcane in the country. Livestock produces 42.119 million tons of milk, making Pakistan 4th largest producer of milk in the world (GOP, 2008). Buffalo is the largest milk producing animal followed by cow as these two species produced 62.3% and 34.28% milk during 2007-08 respectively. Although the major part of milk is produced by buffalo and cattle, however goat and sheep contribute towards total milk supply in the country (GOP, 2008).

Livestock in KP contributes 57.5% towards provincial GNP. This shows that livestock is significant part of the KP economy. In KP total milk production during the year 2007-08 was 5.044 million tones while per capita availability was 141 kg per annum which is higher as compared to national level. KP is milk deficit province and relies on milk from Punjab. Like other farm products, the milk production has not been researched adequately in Pakistan. It is evident from the facts that KP is far behind in milk production. But the question arise, how can we increase milk production in our country. There are three possible ways to increase milk production i.e. are by developing and adopting new technologies, by decreasing cost of inputs or by improving management practices.

The ways to increase milk production by adoption of new innovation is a long term process and its needs more fund to allocated for research and development. On the other hand, mostly the farmers in KP are illiterate, conservative and traditional. These factors hinder in diffusion and adoption of new technology at farm level. Empirical studies indicated that potential of new technologies has not been fully exploited due to inefficient decision making process at farms. Aspect relating to farm management practices is the most key factor responsible for not fully utilization of potential of new technologies.
The second option of decreasing cost of inputs is little hope in current situation. Because over the recent years prices of the petroleum products, were revised upward several times and this trend is likely to continue in future. Similarly, there was increase in the prices of gas, electricity and other agricultural inputs. Historically, in Pakistan, increase in prices of agricultural/livestock inputs has been much higher than the increase in prices of agricultural/livestock outputs (GoP, 2008). Under these circumstances there is little hope of decrease in prices of livestock inputs. Nevertheless, there is room for decreasing cost of producing through improvement in the management practices. When economists talk about improvement in the management practices they talk in terms of ‘technical efficiency’ and ‘allocative efficiency’. Technical efficiency has been defined as firm’s ability to produce maximum output given a set of inputs and technology. Allocative (or price) efficiency measures firm’s success in choosing optimal proportions, i.e. where the ratio of marginal products for each pair of inputs is equal to the ratio of their market prices. Technical efficiency plus allocative efficiency constitute economic efficiency (Farrell, 1957).

In Pakistan several studies have tried to measure technical, economic efficiency of farms but little work has been done to estimate economic efficiency of livestock products. According to these studies farmers’ technical efficiency, in Pakistan ranges from 57 to 88 % (Ali and Chaudry (1990)), Shah et al (1995), Shafiq and Rehman (2000), Ahmad and Qureshi (1999), Ahmad and Shami (1999) and Battese et al (1986)). Bashir et al (2006) use restricted translog production model to estimate allocative efficiency of wheat growers in Peshawar Valley. Average allocative efficiency was 72%. They recommended that for increase in allocative efficiency farmers need to increase the use of nitrogen and phosphorous and decrease the use of tillage and irrigation.

The studies carried out previously are limited in their scope and analysis since most of them simply describe some aspect of the institutional arrangements. Thus, the existing literature on efficiency of milk production is inadequate. Moreover, the information that is available is outdated and not presented in a way, which is helpful to policy makers. Similar economics efficiency analysis of milk production have been carried-out by previous researchers such as Jik et al 1988, who study farm level technical performance in Kyungki milk production and conclude that the technical efficiency indices range from 0.32 to 0.95 with the mean 0.7995 and suggest that there remains a large room for increasing production level of low efficient dairy farms.

This study was conducted in Peshawar district to determine the Milk production economic efficiency. Peshawar is purposively selected because of major milk producing districts in KP (GOP, 2006). Peshawar host 143481 and 223150 Buffalos and cow respectively. In addition, the geographical location of this district is such that could give fair representation to each zone of the province. This study is therefore initiated to fill the gap in literature and also to be used by all stakeholders having the following objectives:

i. Determining return to scale in milk production.

ii. To measure economic, technical and allocative efficiency of milk production in district Peshawar.

MATERIALS AND METHODS

This section explains the mechanics of the research study and describes the universe, data collection procedure, sample size, sampling techniques and econometric analysis.

Description of the Universe

For this study Peshawar was purposively selected since major milk producing district in KP (GOP, 2006). As from district livestock census Peshawar has 143481 buffalos and host 223150 cows. In addition, the geographical location of this districts is such that could give fair representation to each zone of the province. Majority of the farmers of this district keep livestock for agricultural purposes as well as to supplement their income.

Data collection procedure and Sample size

This research will be based on primary data as well as secondary data. The primary data was collected through questionnaire, while the secondary data was amassed from various published and unpublished sources. In the light of study objectives a questionnaire was prepared and pre test in the field. The primary data regarding buffalo and cow milk was collected directly from 100 sampled respondents.

Sampling Technique

Data pertaining to dairy sector was collected by use of multistage stratified random sampling technique. In first stage from two villages was randomly selected. In second stage from these two villages 50 buffalo milk producers and 50 cow milk producers randomly selected was included in the sample. The respondents was be categorized into three groups on the basis of herd size as follows;

Small; 1-10
Allocative Technical and Economic efficiency

Technical efficiency has been defined as firm’s ability to produce maximum output given a set of inputs and technology. Allocative (or price) efficiency measures firm’s success in choosing optimal proportions, i.e. where the ratio of marginal products for each pair of inputs is equal to the ratio of their market prices. Technical efficiency plus allocative efficiency constitute economic efficiency. The concept of technical and allocative efficiency and their measurement, may be explained with the help of Farrell’s diagram.

In Figure 1, two inputs, X1 and X2, are represented on the horizontal and vertical axes, respectively. SS’ is an isoquant representing various combinations of inputs (X1 and X2) used to produce a certain quantity of output (Y). All points on this isoquant reflect technically efficient production. An effort is made to measure the efficiency of a particular firm, which is operating at a point P. At this point (P), the particular firm produces the same level of output (Y) as produced on isoquant, SS’. To define the technical efficiency of the observed firm, a line is drawn from the origin to the point P. This line crosses the isoquant at the point Q. In the case of a technically efficient firm, the same amount of output (Y) is produced using inputs (X1 and X2) defined by the point Q. Inputs are not used efficiently by observed firm P. So the technical efficiency of the observed firm is defined as the ratio of the distance from the point Q to the origin, over the distance of the point P from the origin:

\[ \text{TE} = \frac{OQ}{OP} \]

Figure 1. Farrell’s Measure of Technical and Allocative Efficiency

If the input prices are available, allocative efficiency could also be defined. An isocost line, AA’, is drawn tangential to the isoquant, SS’, at the point Q’, which intersects the line OP at the point R. For the output quantity produced at the point Q, the best use of inputs is at the point Q’ because it incurs the minimum cost. Therefore, the point Q is not an optimal point because the distance, RQ (cost), can be reduced without any reduction in output. Allocative efficiency is defined as the ratio of the distance of the point R to the origin over the distance of the point Q from the origin:

\[ \text{AE} = \frac{OR}{OQ} \]

Economic efficiency is the product of technical efficiency and allocative efficiency:

\[ \text{EE} = \frac{(OQ/OP)(OR/OQ)}{OP} = \frac{OR}{OP} \]

Stochastic Frontier Production and cost Functions

By production function, we mean that factors of production, such as land, labour, capital and entrepreneur are combined together to produce good and services. Factor of production have derived demand because factor of
production alone provide no utility to human being. According to Battese and Taylor (1986), production is the maximum output that a firm can attain from a given set of inputs with the hand technology. A production function in mathematical form is expressed as

\[ Y = f(X) \]

Where Y denotes output of a firm, X shows a vector inputs used in the production process.

The stochastic frontier production frontier (also called composed error) model introduced by Aigner et al. (1977) and Meeslen and Ven Den broeck (1977) will be use here. Given n individuals farmers, stochastic production frontier for observation t is written as:

\[ Y_i = f ( X_i , \beta) + \epsilon_i \quad (i = 1,2 ,\ldots , I) \]  

(1)

Where \( Y_i \) is output obtained by farmer i, \( X_i \) is vector of input for farmer i, \( \beta \) is vector of parameter to be estimated, \( \epsilon_i \) is error term for farmer i. The essential idea behind the stochastic frontier model is that the error term is composed of two components.

\[ \epsilon_i = V_i - U_i \]  

(2)

Where \( V_i \) is symmetric (-\( \infty < V_i < \infty \)) and captures the stochastic effects outside the farmers, control such as weather, breakdowns and natural disasters. It also captured the observation and measures error on the dependent variable under the control of the farmer (\( U_i > 0 \)) and captured the technical inefficiency of the farmer t. The term \( U_i \) represent technical inefficiency in the sense that at measures the shortfall of output (\( Y_i \)) from its maximum possible value given the stochastic Frontier \( f ( X_i , \beta) + V_i \). In other words, technical efficiency is measure by the ratio \( Y_i / f ( X_i , \beta) \) rather then by the ratio \( Y_i / f ( X_i , \beta) + V_i \) used by deterministic models. This simply distinguishes of technical inefficiency of the sources of disturbance that are behind the farmers control (Aigner et al. 1977). Notice that the modal collapses to deterministic frontier model when \( v=0 \), and its collapses to the Zellner, Kmenta & Dreze (1966) stochastic production function model when \( u=0 \).

The disturbance U and V are assume to be independent each other. This seems reasonable sense V represents the influence of factors outside the control of the farmer, while U represent technical efficiency under the control of the farmer. The term V and U are also assume to be independent of physical input X. This assumption is less realistic because in practice, the variable in U (management practices) might be correlated with physical input X. However, if management practices are included directly in the production function, the efficiency (precession) of estimates of the production coefficients is reduced due to inclusion of more variables in the production function. It might also cause multicollinearity, especially if the correlation among physical inputs and management practices is high. The stochastic Frontier production model of Aigner et al (1977) assume to be random and independent of X. While this assumption solves the problems of simultaneous equation bias, the estimates of Frontier production function might still be biased due to mis-specification. Even simultaneous equation bias can not be avoided when technical inefficiency ‘U’ is explained with factors under the farmers control. (Aigner et al. 1977 avoid this problem by using the Zellner Kmenta and Dreze behavioral assumption). Thus there are potentially significant problem in estimation of both the frontier production function and the direct production function (when management variables are included in the production function). In the frontier production function we might end of with biased estimates and in the direct production function we lose precession due to inclusion of more variables in the production function.

Model Specification

The stochastic frontier production function model of Cobb-Douglas functional form is employed to estimate technical and allocative efficiencies of the farmers in the study areas the functional form has been widely used in farm efficiency for the developing and developed countries. It meets the requirement of being self-dual, allowing an examination of economic efficiency and lastly Kopp and Smith (1980) suggested that functional form has a limited effects on empirical efficiency measurement. Also Cobb-Douglas function have disadvantages as its place restrictions on the relationships between inputs which may not be realistic. For example its assumes an elasticity of substitution between any two inputs in one.

The Cobb-Douglas production functional form which specifies the production technology of the farmers is expressed as follows:

\[ Y_i = f ( X_i; \beta) \exp V_i - U_i \quad \ldots \ldots \]  

(3)

Where \( Y_i \) represent the value of output, \( X_i \) represents the quantity of input used in the production. The \( V_i \) and \( U_i \) are assumed to be independent and identically distributed random errors, having normal \( N(0, \sigma^2) \) distribution and
independent of the U_i. The U_i are technical inefficiency effects, which are assumed to be non-negative truncation of the half-normal distribution N (μ, σ_u^2).

The technical efficiency of individual farmers is defined in terms of the ratio of observed output to the corresponding frontiers output, conditional on the level of input used by the farmers. Hence the technical efficiency of the farmer is expressed as

\[ TE_i = \frac{Y_i}{Y_i^*} = f(X_i; \beta) \exp(V_i - U_i) / f(X_i; \beta) \exp V_i = \exp(-U_i) \] ……….. (4)

Where: Yi is the observed output and Yi* is the frontiers output. The TE ranges between 0 and 1 that is 0 ≤ TE ≤ 1. The corresponding cost frontier of Cobb-Douglas functional form which is the basis of estimating the allocative efficiencies of the farmers is specified as follows:

\[ Ci = g(P_i; \alpha) \exp(V_i + U_i); i = 1, 2, ..., n \] ……….. (5)

Where Ci represents the total input cost of the i-th farmer; g is a suitable function such as the Cobb-Douglas function; Pi represents input prices employed; α is the parameter to be estimated, V_i and U_i are random errors and assumed to be independent and identically distributed truncations (at zero) of the N (μ, σ_v^2) distribution. U_i provides information on the level of allocative efficiency of the i-th farm. The allocative efficiency of individual farmers is defined in terms of the ratio of the predicted minimum cost (C_i^*) to observed cost (C_i). That is

\[ AE_i = C_i^*/C_i = \exp(U_i) \] ……….. (6)

Hence, allocative efficiency ranges between zero and one.

Method of Data Analysis

Descriptive statistics (mean and standard deviation) and stochastic frontier production and cost functions were used to analyze the socio-economic characteristics, technical and allocative efficiency respectively of the farmers. While the farmer’s economic efficiencies were estimated as the product of TE and AE. The production technology of the farmers was assumed to be specified by the Cobb-Douglas frontier production function which is defined by:

\[ \ln Y_i = \ln \beta_i + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + V_i - U_i \] ……….. (7)

Where Y = Total value of milk (Rs),
X_1 = Herd Size (Number),
X_2 = Labour (Number),
X_3 = Quantity of Green fodder (kg),
X_4 = Quantity of Dry fodder (kg),
X_5 = Health cost (Rs),
X_6 = Cost of utensil (Rs),

The Cobb-Douglas cost frontier function for milk production was specified and defined as follows:

\[ \ln C = \alpha_0 + \alpha_1 \ln P_1 + \alpha_2 \ln P_2 + \alpha_3 \ln P_3 + \alpha_4 \ln P_4 + \alpha_5 \ln P_5 + V_i + U_i \] ……….. 8

Where C = total cost of production of milk (Rs)
P_1 = cost of labour (Rs),
P_2 = cost of feed (Rs),
P_3 = cost of health (Rs),
P_4 = Other Operating expenses (Rs),
P_5 = cost of implements use in (Rs),

The technical and allocative inefficiency effects μ_i is defined by:

\[ \mu_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} \] ……….. 9

Where Z_1, Z_2 and Z_3, respectively educational level, farming experience and age of farmers. These are included in the model to indicate their possible influence on the technical efficiencies of the farmers. The β’s, σ’s are scalar parameters to be estimated. The variances of the random errors, σ_v^2 and that of the technical and allocative inefficiency effects σ_u^2 and overall variance of the model σ^2 are related thus: σ^2 = σ_v^2 + σ_u^2 and the ratio γ = σ_u^2 / σ^2, measures the total variation of output from the frontier which can be attributed to technical or allocative inefficiency (Battese and Corra, 1977). The estimates for all the parameters of the stochastic frontier production function and the inefficiency model are simultaneously obtained using STATA.

RESULTS AND DISCUSSION

Summary Statistics

The summary statistics of variables for the production and cost frontier estimation is presented in Table I. The table show that the average total milk produced is 17684.15 liters with a standard deviation of 13186.15. The large
variability by the standard deviation implies that the farmers operated at different levels of herd sizes which tend to affect their output levels. The mean herd size was 9.4 animal with a standard deviation of 5.88. The mean total family and hired labour used was 187.23 with a standard deviation of 123.44. This is an indication that milk production is a labour intensive exercise considering the large variability recorded. The average cost of feed was Rs. 30854.06 with a standard deviation of Rs. 11235.

Table I  Summary statistics of variables of stochastic frontier production and cost variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unit</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total milk produced</td>
<td>Liter</td>
<td>17684.15</td>
<td>13186.15</td>
</tr>
<tr>
<td>Herd size</td>
<td>No</td>
<td>9.4</td>
<td>5.88</td>
</tr>
<tr>
<td>Labour</td>
<td>No</td>
<td>187.23</td>
<td>123.44</td>
</tr>
<tr>
<td>Cost of Feed</td>
<td>Rs</td>
<td>30854.06</td>
<td>11235.9</td>
</tr>
<tr>
<td>Cost of Concentrate</td>
<td>Rs</td>
<td>1125</td>
<td>657.752</td>
</tr>
<tr>
<td>Health Cost</td>
<td>Rs</td>
<td>18354</td>
<td>16060.9</td>
</tr>
<tr>
<td>Cost of utensils</td>
<td>Rs</td>
<td>1234.89</td>
<td>1118.32272</td>
</tr>
<tr>
<td>Total cost of production</td>
<td>Rs</td>
<td>84530.78</td>
<td>610306</td>
</tr>
<tr>
<td>Age of Farmers</td>
<td>Years</td>
<td>54.23</td>
<td>35.59</td>
</tr>
<tr>
<td>Farming Experience</td>
<td>Years</td>
<td>21.32</td>
<td>13.18</td>
</tr>
<tr>
<td>Educational level</td>
<td>Years</td>
<td>9.76</td>
<td>5.885853</td>
</tr>
</tbody>
</table>

Productivity Analysis

The maximum likelihood estimates of the stochastic frontier production function for milk production in the study area are presented in Table II. The estimated coefficients of all the parameters of production function are positive meaning that total milk production increases by the value each of coefficient as the quantity of each variable increase by 1 unit. The variables, cost of herd size, labour and costs of farm tools were statistically significant at 5% level. The estimated elasticities of the explanatory variables of the general model show that all the variables have positive decreasing function to the factors indicating that the variables allocation was in stage II of production surface (the stage of efficient factor usage). The returns to scale (RTS) in Table III was 1.074 indicating an increasing returns to scale and that milk production was in stage I of the production surface. This shows that efforts should be made to expand the present scope of production to actualize the potential in it, that is, more of the variables input could be employed to achieve more output. The estimates of the parameters of stochastic frontier cost model of milk in the sample area were presented in Table IV. The estimated coefficients of the parameters of cost function were positive. This implies that the variables (cost of labor, cost of feed, cost of health, other operating expenses and cost of implement use) used in regression analysis have direct relationship with total cost of production used as output. In other words, cost of milk production increases by the value of each coefficient as the quantity of each variable is increased by one. All the cost variables were significant to the total cost of production. The significance is confirmed by the t-ratio test at 5% level of significance.

Table II  Maximum likelihood estimates of stochastic frontier production function

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>( B_0 )</td>
<td>16.027 (28.491)</td>
<td>14.31 (25.431)</td>
</tr>
<tr>
<td>Herd Size (No)</td>
<td>( B_1 )</td>
<td>0.5094 (2.55)</td>
<td>0.300 (5.70) *</td>
</tr>
<tr>
<td>Labor (No)</td>
<td>( B_2 )</td>
<td>0.381 (2.10)</td>
<td>0.290 (2.00) *</td>
</tr>
<tr>
<td>Quantity of green fodder (Kg)</td>
<td>( B_3 )</td>
<td>0.21 (3.50)</td>
<td>0.061 (2.32) *</td>
</tr>
<tr>
<td>Quantity of dry fodder (Kg)</td>
<td>( B_4 )</td>
<td>1.90 (1.54)</td>
<td>0.301 (3.30) *</td>
</tr>
<tr>
<td>Health cost (Rs)</td>
<td>( B_5 )</td>
<td>0.311 (2.55)</td>
<td>0.101 (2.65) *</td>
</tr>
<tr>
<td>Utensils (Rs)</td>
<td>( B_6 )</td>
<td>5.84 (2.31)</td>
<td>0.021 (3.06) *</td>
</tr>
</tbody>
</table>

Inefficiency Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>( \delta_0 )</td>
<td>0</td>
<td>-5.023 (-3.11) *</td>
</tr>
<tr>
<td>Education Level (No of schooling year)</td>
<td>( \delta_1 )</td>
<td>0</td>
<td>-0.401 (-2.21) *</td>
</tr>
<tr>
<td>Farming Experience (No of year)</td>
<td>( \delta_2 )</td>
<td>0</td>
<td>-0.193 (2.91) *</td>
</tr>
<tr>
<td>Age of farmer (Year)</td>
<td>( \delta_3 )</td>
<td>0</td>
<td>5.193 (3.31) *</td>
</tr>
</tbody>
</table>

Variance

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sigma square</td>
<td>( \delta^2 )</td>
<td>0.56</td>
<td>3.021 (3.412) *</td>
</tr>
<tr>
<td>Gamma</td>
<td>( \gamma )</td>
<td>0</td>
<td>0.851 (65.20) *</td>
</tr>
<tr>
<td>Log likelihood function</td>
<td>Llf</td>
<td>-16.40</td>
<td>12.43</td>
</tr>
</tbody>
</table>

Figure in parenthesis are t-ratio

* Statistically significant at 5% level

Table III  Elasticity of production and return to scale

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd Size</td>
<td>0.300 (5.70)*</td>
</tr>
<tr>
<td>Labor</td>
<td>0.290 (2.00)*</td>
</tr>
</tbody>
</table>
The study revealed that there was presence of technical and allocative inefficiency effects in milk production as confirmed by the test of hypothesis for the presence of inefficiency effects using the generalized likelihood ratio test. The chi-square computed for the presence of technical inefficiency effect is 61.21 while the critical value of the chi-square at 5% level of significance with 6 degree of freedom $\chi^2 (5%, 6)$ was 18.43 while the computed chi-square for the presence of allocative inefficiency is 73.07 while the critical value of the chi-square at 5% level of significance with 6 degree of freedom $\chi^2 (5%, 6)$ was 18.43. The null hypothesis of no technical and allocative inefficiency effects in the course of the farmers production $\gamma = 0$, was strongly rejected. Thus model I for both production and cost function was not an adequate representation of the data, hence model 2 was preferred model for further economic analysis. The estimated gamma parameter ($\gamma$) of model 2 for production function was 0.851, indicating that about 85% of the variation in the output of milk among the farmers was due to differences in their technical efficiencies while the estimated gamma parameter ($\gamma$) of model 2 for the cost function was 0.781 indicating that about 78% of the variation in the total cost of production among the farmers was due to the presence of allocative inefficiency.

**Table IV  Maximum likelihood estimates of stochastic frontier cost function**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>$B_0$</td>
<td>2.03 (8.39)*</td>
<td>2.38 (7.64)*</td>
</tr>
<tr>
<td>Cost of labor</td>
<td>$B_1$</td>
<td>0.198 (5.45)*</td>
<td>0.200 (5.70)*</td>
</tr>
<tr>
<td>Cost of feed</td>
<td>$B_2$</td>
<td>0.381 (4.10)*</td>
<td>0.380 (4.00)*</td>
</tr>
<tr>
<td>Health cost</td>
<td>$B_3$</td>
<td>0.251 (3.50)*</td>
<td>0.261 (3.32)*</td>
</tr>
<tr>
<td>Other Operating expenses</td>
<td>$B_4$</td>
<td>2.33 (2.54)*</td>
<td>2.301 (2.30)*</td>
</tr>
<tr>
<td>Cost of implement</td>
<td>$B_5$</td>
<td>0.111 (3.55)*</td>
<td>0.101 (3.65)*</td>
</tr>
<tr>
<td><strong>Inefficiency Model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>$\delta_0$</td>
<td>0</td>
<td>-0.023 (-0.411)*</td>
</tr>
<tr>
<td>Year of schooling</td>
<td>$\delta_1$</td>
<td>0</td>
<td>-1.101 (-2.91)*</td>
</tr>
<tr>
<td>Farming Experience</td>
<td>$\delta_2$</td>
<td>0</td>
<td>-1.183 (1.99)*</td>
</tr>
<tr>
<td>Age of farmer</td>
<td>$\delta_3$</td>
<td>0</td>
<td>0.043 (-1.23)</td>
</tr>
<tr>
<td>Variance</td>
<td>$\delta^2$</td>
<td>0.32</td>
<td>4.221 (8.312)*</td>
</tr>
<tr>
<td>Gamma</td>
<td>$\gamma$</td>
<td>0</td>
<td>0.781 (8.98)*</td>
</tr>
<tr>
<td>Log likelihood function</td>
<td>Llf</td>
<td>-23.845</td>
<td>19.66</td>
</tr>
</tbody>
</table>

**CONCLUSION AND RECOMMENDATIONS**

The study revealed that milk farmers were yet to achieve their best. This was due to the presence of both technical and allocative inefficiency effects in their operations. Economic efficiency (EE) of the farmers could be improved substantially and that technical inefficiency constitutes a more serious problem than allocative inefficiency judged by the average technical and allocative efficiency recorded in the area. Allocative efficiency appears to be more significant than TE as source of gain in EE meaning that allocative inefficiency is not a serious problem to the milks farmers. That is, the milk farmers are capable of producing a given level of output at a minimum cost input ratio. The farmers were small scale and resource-poor, but they are fairly efficient in the use of their resources and any expansion in the use of any resources would bring more than proportionate increase in their output, given the increasing returns to scale value obtained for the study.

The fact that rising age would lead to a decline in the efficiency means, government policy should focus on ways to attract and encourage young people who are agile and aggressive in Dairy business. This group of people would be able to put in a lot of efforts at raising the current level of efficiency, given a conducive policy environment. Also, the livestock farmers should be given assistance in form of loan in order to be able to cope with increasing cost of inputs. Government should therefore show more seriousness in the implementation of agricultural credit schemes because livestock farmers in the village could still not have access to agricultural development banks.

**REFERENCES**


