Farm Household Technical Efficiency: A Study on Rice Producers in Selected Areas of Jamalpur District in Bangladesh

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Abstract

Due to high population growth rate, food security became a burning issue in Bangladesh economy where forty percent people lives under poverty level. Efficiency of rice producer is an important factor because of rice is the staple food in Bangladesh. This paper attempted to examine the technical efficiency of rice farmers and inefficiency factors which affects production. One hundred fifty (150) rice farmers has been selected through random sampling procedure from five upazilas in Jamalpur district which comprising of 30 farmers from each upazila. The paper has employed stochastic production frontier approach (using Frontier 4.1 package) to estimate technical efficiency and its determinants for Boro and Aman rice. Result found that mean technical efficiency of the Boro (95%) and Aman (91%) rice farmers was highly satisfactory. Farm size, human labor, pesticide, irrigation and power tiller were important factors for production of Boro and Aman rice. Younger farmers were more efficient than the elder farmers. Education and experience has expected negative sign which can reduce the farmer's inefficiency in the study area. The study has suggested that since farmers are enough efficient to the existing varieties, so government should give emphasis on rice research to develop new varieties which can ensure food security in Bangladesh.

Keywords: Rice farmers, stochastic frontier and technical efficiency, Bangladesh

1. Introduction

Agriculture is the corner stone in the Bangladeshi economy. The agriculture sector contributes about 19 % of GDP and is providing livelihood for over 80% of the population (BBS 2007). Nevertheless, food problem is one of the major problems of Bangladesh. Unfortunately, the production in such a vital sector still depends on nature and annual food production target varies widely from year to year. Although agriculture is still the largest sector of the economy, its contribution to gross domestic production (GDP) is declining. Slow agricultural growth means that the majority of the rural population earns low incomes and as such the rate of savings and investment opportunities are severely limited.

Bangladesh has about 13.80 million hectares of cropped area of which 2.91 million hectares are single cropped, 3.94 million hectares are double cropped and 1.01 million hectares are triple cropped area. In total net sown area is about 7.85 million hectares and the cropping intensity is 180 percent (BBS 2007). Rice, wheat, pulses, vegetables, oil seeds, sugarcane and potato are the major crop grown in Bangladesh. Rice is the staple food and the most important crops that is grown in the entire three crop seasons namely *Aman, Boro and Aus*. In normal years, the production of rice usually is about 18 million tons. If there is a bumper crop, it may exceed 20 million tons but even then Bangladesh has to import some rice almost every year. This is due to the pressure of rising population. However, the population growth rate, now-a-days runs behind the growth rate of food grains. During the last decade, production of paddy increased at the rate of 2.83 percent annually (BBS 2007). It can be seen that agriculture meets most of the food demand.

The measurement of the productive efficiency in agricultural production is an important issue from the standpoint of agricultural development exercises in developing countries since it gives pertinent information useful for making sound management decisions in resource allocations and for formulating agricultural policies. In the productive efficiency arena, we are familiar with three types of efficiency, namely, technical, allocative and economic efficiencies. Technical efficiency refers to the ability of a farm to obtain maximum output from a given set of inputs under certain production technology whereas allocative efficiency reflects the ability of a farm to use the inputs in optimal properties, given their respective prices. Economic efficiency, which combines technical and allocative efficiencies, reflects the ability of a production unit to produce a well- specified output at the minimum cost. Against the above background, the main objective of this paper is to assess the technical efficiency and its determinants of rice production in Jamalpur district of Bangladesh. Five hypotheses has been tested to assess inefficiency effects for both type of rice. These hypotheses are; (i) no existence of inefficiency effect; (ii) no effect of age, education and experience; (iii) no effect of age on inefficiency; (iv) no effect of education on inefficiency and (v) no effect of experience on inefficiency. In Bangladesh, where resources are scarce and opportunities for new technologies are lacking, efficiency (or inefficiency) studies will be able to show that it is possible to raise productivity by improving efficiency without new or developing new technology. Thus, this finding of the study will be useful for rice producer as well as policy makers.

2. Methodology
2.1. Theoretical Framework

Technical efficiency refers to the ability of a firm to produce maximum possible output with a minimum quantity of inputs, under a given technology. A technically efficient firm will operate on its frontier production function. Given the relationship of inputs in a particular production function, the firm is technically efficient if it produces on its outer bound production function to obtain the maximum possible output, which is feasible under the current technology.

Farrell's (1957) seminal article on efficiency measurement led to the development of several approaches to efficiency and productivity analysis. Among these the stochastic frontier production (Aigner *et al.,* 1977); (Meeusen and van den Broeck) and Data Envelopment Analysis (DEA) (Charnes *et al.,* 1978) are the two principal methods. As noted by Coelli *et al.,* (1998), the stochastic frontier is considered more appropriate than DEA in agricultural applications, especially in developing countries, where the data are likely to be heavily influenced by the measurement errors and the effects of weather conditions, diseases, etc. Thus following Aigner *et al.* (1977) and Meeusen and van den Broeck (1977), the stochastic frontier production with two error terms can be modeled as:

$$Y_i=f(X_i,\beta)exp(V_i-U_i) \tag{1}$$

Where Y_i is the production of the i-th farm (i=1,2,3............n), X_i is a (lxk) vector of functions of input quantities applied by the i-th farm; β is a (kxl) vector of unknown parameters to be estimated, V_is are random variables assumed to be independently and identically distributed $(N\ (O,\delta^2_v)$ and independent of $U_i s$ and the $U_i s$ are non-negative random variables, associated with technical inefficiency in production assumed to be independently and identically distributed and truncations (at zero) of the normal distribution with mean, $Z_i\delta$ and variance σ^2_u $(|N(Z_i\delta, \sigma^2_u)|)$; Z_i is a (lxm) vector of farm specific variables associated with technical inefficiency, and δ is a (mxl) vector of unknown parameters to be estimated (Sharma and Leung, 1998).

Following Battese and Coelli (1995), the technical inefficiency effects, U_i in equation (l) can be expressed as:

$$U_i = Z_i\delta + W_i \quad (2)$$

Where W_i are random variables, defined by the truncation of the normal distribution with zero mean and variance σ^2_u, such that the point of truncation is $Z_i\delta$, i.e $W_i \geq - Z_i\delta$. Beside the farm-specific variables, the Z_i variables in equation (2) may also include input variables in the stochastic production frontier (1), provided that the inefficiency effects are stochastic. If Z variables also include interactions between farm-specific and input variables, then a Huang and Lie (1994) non-neutral stochastic frontier is obtained.

The technical efficiency of the i-th sample farm, denoted by TEi is given by:

$$TE_i = exp\ (-U_i) = Y_i/f\ (X_i\beta)\ exp\ (V_i) = Y_i/Y_i^* \quad (3)$$

Where $Y_i^* = f(X_i\beta)\ exp\ (V_i)$ is the farm specific stochastic frontier. If Y_i is equal to Y_i^* then TE_i=1, reflects 100% efficiency. The difference between Y_i and Y_i^* is embedded in U_i (Dey *et al.,* 1999). If U_i=0, implying that production lies on the stochastic frontier, the farm obtains its maximum attainable output given its level of input. If U_i<0, production lies below the frontier-an indication of inefficiency.

The maximum likelihood estimate (MLE) of the parameters of the model defined by equations (1) and (2) and the generation of farm-specific TE defined by (3) are estimated using the FRONTIER 4.1 package (Coelli, 1994). The efficiencies are estimated using a predictor that is based on the conditional expectation of *exp (-U)* (Battese and Coelli, 1993; Coelli, 1994). In the process, the variance parameters σ^2_u and σ^2_v are expressed in terms of the parameterization:

$$\sigma^2 = (\sigma^2_u + \sigma^2_v) \quad (4)$$

and

$$\gamma = (\sigma^2_u/\sigma^2) \quad (5)$$

The value of γ ranges from 0 to 1 with values close to 1 indicating that random component of the inefficiency effects makes a significant contribution to the analysis of the production system (Coelli and Battese, 1996).

2.2. Model Specification Tests

The use of a generalized likelihood ratio test is another way of testing if inefficiency effects are about from the model. This is used in testing the significance of the model as in the F-test in the Ordinary Least Squares (OLS) estimation. It can also be used in testing the functional form of the model (e.g. Cobb-Douglas versus translog) and is more or less equivalent of the Chow test (Green, 1990; Johnston, 1984) in OLS estimation. The generalized likelihood ratio test statistic is defined by:

$$\lambda = -2\ log\ [L\ (H_o)/L\ (H_1)] \quad (6)$$

Where $L\ (H_o)$ is the value of the log-likelihood function of a restricted frontier model as specified by a null hypothesis H_o: and $L(H_1)$ is the value of the log-likelihood function of unrestricted model (alternative hypothesis H_1). The test statistic has a χ^2 or mixed χ^2 distribution with degrees of freedom (df) equal to the difference between the number of parameters involved in H_o and H_1.

2.3. Empirical Model

In the study area, mainly Boro and Aman rice are produced in two seasons. Here we estimated two models for two types of rice. Two types of functions namely; Cobb-Douglas and translog dominate the technical efficiency literature. Therefore, a Cobb-Douglas specification has been given. In this study, two Cobb-Douglas production functions has been estimated for Boro and Aman rice. The stochastic production functions for the sample Boro rice farmers is specified as:

$$InY_i = \beta o + \beta_l\, ln\,(X_l) + \beta_2\, ln\,(X_2) + \beta_3\, ln\,(X_3) + \beta_4\, ln\,(X_4) + \beta_5\, ln\,(X_5) + \beta_6\, ln\,(X_6) + \beta_7\, ln\,(X_7) + \beta_8\, ln\,(X_8) + V_i - U_i \quad (7)$$

Where, *In* = Natural logarithm; Y_i = Boro rice (Kg/farm); X_1= Farm size (decimal); X_2= No. of human labor (Man-day); X_3 = Seed/seedling (Kg); X_4 = Fertilizer (Kg); X_5 = Manure (Tk.); X_6 = Pesticide (Tk.); X_7 = Power tiller (Tk.); X_8= Irrigation cost (Tk.)

The technical inefficiency effects, U_i are defined as:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + W_i \quad (8)$$

Where, Z_1 = Age of the farmers (years); Z_2 = Education (years of Schooling); Z_3 = Experience (years)

The stochastic production function for the sample Aman rice farmers is specified as:

$$InY_i = \beta o + \beta_l\, ln\,(X_l) + \beta_2\, ln\,(X_2) + \beta_3\, ln\,(X_3) + \beta_4\, ln\,(X_4) + \beta_5\, ln\,(X_5) + \beta_6\, ln\,(X_6) + V_i - U_i \quad (9)$$

Where, *In* = Natural logarithm; Y_i = Aman paddy (Kg/farm); X_1= Farm size (decimal); X_2= No. of labour (Man-day); X_3 = Seed/seedling (Kg); X_4 = Fertilizer (Kg); X_5 = Pesticide (Tk.); X_6 = Power tiller (Tk.)

The technical inefficiency effects, U_i are defined as:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + W_i \quad (10)$$

Where, Z_1 = Age of the farmers (years) Z_2 = Education (years of Schooling) Z_3 = Experience (years)

2.4. Data and Descriptive Statistics

This study is based on the cross-sectional household level data collected from Jamalpur district using random sampling procedure in 2007. Jamalpur is rice producing area and it is situated in northern part of Bangladesh. Mainly Boro and Aman rice are produced in this study area and information has been collected for both (Boro and Aman) rice to measure technical efficiency separately. Total 150 farmers were selected from five upazilas under Jamalpur district namely; Jamalpur sadar, Sarishabari upazila, Melandaha upazila, Islampur upazila and Dewanganj upazila. From each upazila, three villages has been selected and from each village 10 rice farmers were selected randomly. Table 1 represents the descriptive statistics of data which has been used to measure stochastic frontier production function and technical inefficiency function.

Table 1: Description of variables used in the stochastic frontier production function and technical inefficiency function

Variable	Boro		Aman	
	Variable Symbol	Mean value	Variable Symbol	Mean value
Output Variable				
Rice Production (Kg/farm)	Y	1923		1222
Input variable				
Farm size (decimal)	X_1	64.5	X_1	63.46
Human labour (Man-days)	X_2	25.02	X_2	21.61
Seed/seedling (Kg)	X_3	14.59	X_3	13.55
Fertilizer (Kg)	X_4	118.55	X_4	69.7
Manure (Taka)	X_5	441.33		
Pesticide (Taka)	X_6	289.36	X_5	243.33
Power tiller (Taka)	X_7	740.64	X_6	742.42
Irrigation (Taka)	X_8	1673.75		
Farm-specific variables affecting TE				
Farmers age	Z_1		47.69	
Farmers year of schooling	Z_2		10.74	
Farmers experience	Z_3		14.95	

3. Result and discussion

3.1. Technical Efficiency Measurement of Boro Rice Farmers

As explained earlier (in methodology) the production frontier and the inefficiency function have been estimated by invoking frontier 4.1. The estimated parameter of the production frontier is presented in Table 2 for Boro rice production. Results indicate that five variables out of eight of the explanatory variables in the production frontier are statistically significant. Negative but significant sign of power tiller indicates that production reduces with the increases of power tiller cost .This is because of fuel cost has increased three to four times during last five years. It is a major problem not only in the study area but also overall Bangladesh. The negative but insignificant coefficient of manure indicates that as manure increase, rice production decreases. Perhaps the farmers use over doses of manure for Boro rice production and rice production is adversely affected by it.

Table 2: Maximum likelihood estimate of stochastic Cobb-Douglas production frontier and technical inefficiency model for Boro paddy production

Variables	Parameter	Coefficient
Stochastic Frontier:		
Constant	β_0	3.3670***
Ln (farm size)	β_1	0.8357***
Ln (human labour)	β_2	0.0441*
Ln (seed/seedling)	β_3	0.0165
Ln (fertilizer)	β_4	0.0332
Ln (manure)	β_5	-0.0003
Ln (pesticide)	β_6	0.0333*
Ln (power tiller)	β_7	-0.0532*
Ln (irrigation)	β_8	0.0688***
Log-likelihood value	210.66	
Mean technical efficiency	**95.38**	
Variance Parameter:		

Sigma square	σ^2	0.0928*
Gamma	γ	0.989***
Inefficiency Function:		
Constant	δ_0	-4.2164
Age	δ_1	0.0665
Education	δ_2	-0.0350**
Experience	δ_3	-0.0295

***Significant at 1% level, ** significant at 5% level, * significant at 10% level

Since the production frontier is of Cobb-Douglas type, its parameters have interpretation similar to elasticities of production. The effects of farm size, irrigation and location are positive and statistically highly significant. That means, these variables has positive impact on Boro rice production. One the other hand, only one variable (education) out of three explanatory variables of the inefficiency function is significant. It means that higher educated farmers are more efficient than farmers with lower level of education. The positive but insignificant coefficient of age of the farmers indicates that as the farmers' age increases, the inefficiency increases. It means that, young farmers are more efficient than the old farmers. Training also has positive effect on inefficiency in Boro rice production but it is not significant. The mean technical efficiency of the Boro rice producer is 95 percent in the study area. The variance parameters are also found to be highly statistically significant.

3.2. Technical Efficiency Measurement of Aman Rice Farmers

Table 3 shows the estimation of the maximum likelihood estimates for parameters of the Cobb-Douglas Stochastic Production Frontier and technical inefficiency effect model for Aman rice production. It is found that farm size, pesticide use and location have positive and highly statistically significant (significant at 1% level) impact on Aman rice production. Power tiller cost has positive impact on Aman production and it is significant at 5% level. Human labor and fertilizer has positive impact but not significant. In inefficiency function, the age of the farmers has an insignificantly positive impact upon the inefficiency effect for Aman production. It means that the younger farmers are more technically efficient than the older farmers. Education and experience has insignificantly negative impact upon the inefficiency effects for Aman production. It reveals that education and experience is responsible for inefficiency but not significantly. The overall mean technical efficiency of the Aman rice farmers is 91 percent. The variance parameter γ associated with the variance in the stochastic frontier is significantly positive for Aman rice production. This means that about 94 percent of the difference between observed output and maximum production frontier output is caused by differences in farmers' level of technical efficiency.

Table 3: Maximum likelihood estimate of stochastic Cobb-Douglas production frontier and technical inefficiency model for Aman paddy production

Variables	Parameter	Coefficient
Stochastic Frontier:		
Constant	β_0	3.2734***
Ln (farm size)	β_1	0.7083***
Ln (human labour)	β_2	0.0122
Ln (seed/seedling)	β_3	-0.0355
Ln (fertilizer)	β_4	0.0082
Ln (pesticide)	β_5	0.0350***
Ln (power tiller)	β_6	0.1172*
Log-likelihood value	129.01	
Mean technical efficiency	**90.79**	
Variance Parameter:		
Sigma square	σ^2	0.0640
Gamma	Γ	0.9401***
Inefficiency Function:		

Constant	δ_0	0.9657
Age	δ_1	0.0068
Education	δ_2	-0.1098
Experience	δ_3	-0.0416

****Significant at 1% level, ** significant at 5% level, * significant at 10% level*

3.3. Test of Hypothesis

Results of the hypotheses tests are presented in Table 4 and Table 5 for Boro and Aman rice production. Relevant null hypotheses tests, namely existence of inefficiency effect in the inefficiency function, were conducted first. In addition, tests concerning the effect of each of the variables in the inefficiency functions were also conducted. The format for the null hypothesis: non-existence of the inefficiency effect **is $\gamma = \delta_0 = \delta_1 = \delta_2 = \delta_3 = 0$** for both Boro and Aman rice. The test statistics was calculated to be 25.00 suggesting that the null hypothesis was rejected for Boro rice (Table 4). The rejection of the null hypothesis supports the existence of inefficiency effect on the Boro production of the sampled farmers. One the other hand for Aman rice the result of test statistics was calculated to be 23.26 suggesting that the null hypothesis was rejected (Table 5). The rejection of the null hypothesis supports the existence of inefficiency effect on the Aman production of the sampled farmers. This implies that the traditional average response function is not an adequate representation for Boro and Aman production.

Table 4: Generalized likelihood ratio test of null hypotheses for parameters of the inefficiency function for Boro paddy production

Test of null hypotheses	Log-likelihood value under null hypotheses	Test statistics	Degrees of freedom	Critical values at 95%	Conclusion
No existence of inefficiency effect ($\gamma = \delta_0 = \delta_1 = \delta_2 = \delta_3 = 0$)	198.16	25.00	5	11.07	Reject H_0
No effect of age, education and experience ($\delta_1 = \delta_2 = \delta_3 = 0$)	208.96	3.4	3	7.81	Accept H_0
No effect of age on inefficiency ($\delta_1 = 0$)	210.46	0.4	1	3.84	Accept H_0
No effect of education on inefficiency ($\delta_2 = 0$)	210.33	0.66	1	3.84	Accept H_0
No effect of experience on inefficiency($\delta_3 = 0$)	210.59	0.14	1	3.84	Accept H_0

The γ (gamma) parameter for Boro and Aman (shown in Table 2 and Table 3) is very close to one and is highly significant. It suggests that the existence of technical inefficiency effect in the stochastic frontier model and that the traditional production function, with no technical inefficiency effects, is not an adequate representation of the data.

The hypothesis relating to whether technical inefficiency effects have the same truncated normal distribution was tested imposing $\delta_1 = \delta_2 = \delta_3 = 0$ for both Boro and Aman rice**.** The test statistics was found to be 18.46 for Aman (Table 5), which is much higher than the critical value supporting the rejection of the null hypothesis. It can therefore be concluded that the inefficiency effects are significantly influenced by age, education and experience of the farmers. One the other hand, the test statistics value for Boro rice was 3.4 and the null hypothesis is accepted.

Table 5: Generalized likelihood ratio test of null hypotheses for parameters of the inefficiency function for Aman paddy production

Test of null hypotheses	Log-likelihood value under null hypotheses	Test statistics	Degrees of freedom	Critical values at 95%	Conclusion
No existence of inefficiency effect ($\gamma = \delta_0 = \delta_1 = \delta_2 = \delta_3 = 0$)	117.38	23.26	5	11.07	Reject H_0
No effect of age, education and experience ($\delta_1 = \delta_2 = \delta_3 = 0$)	119.78	18.46	3	7.81	Reject H_0
No effect of age on inefficiency ($\delta_1 = 0$)	128.94	0.14	1	3.84	Accept H_0
No effect of education on inefficiency ($\delta_2 = 0$)	120.54	16.94	1	3.84	Reject H_0
No effect of experience on inefficiency($\delta_3 = 0$)	120.54	16.94	1	3.84	Reject H_0

The explanatory variables of the inefficiency function were tested separately to examine their effect in the inefficiency function for both Boro and Aman rice (Table 4 & 5). The null hypothesis ($\delta_1 = 0$) for both Boro and Aman implies that age has no effect on the inefficiency. This hypothesis is accepted implies that the inefficiency does not depend on the farmer's age, i.e., farmer's age is not the important factor for Boro and Aman rice production. Again the null hypothesis education and experience ($\delta_2 = 0$ *and* $\delta_3 = 0$) implies that education and experience have no effect on the inefficiency. These hypotheses are accepted for Boro (Table 4) but rejected for Aman (Table 5). In case of Boro, education and experience do not have significant effect on the inefficiency. But in case of Aman, null hypothesis of education and experience were rejected providing support that they have significant effect on the inefficiency. Moreover, signs of each of these variables were negative (both Boro and Aman) indicating that they significantly reduce the inefficiency.

3.4. Technical Efficiency Scores

The distribution of technical efficiency scores relative to the best practice frontier scores are presented in Table 6. The mean technical efficiency was found to be 95 percent for Boro rice and 91 for Aman. It indicates that the rice farmers operate at a high level of efficiency. There appears to be 5% and 9% technical inefficiency at aggregate level for Boro and Aman rice respectively. This implies that the output per farm can be increased on average 5% for Boro and 9% for Aman rice under the existing technology without incurring any additional input. Our test concerning the existence of inefficiency also conforms to this high level of efficiency for both Boro and Aman rice production. In the study area, there was no farmer who operates the farm below 60% technical efficiency levels. In case of Boro, 93 percent of farmers operate their farms between 90-100 percent efficiency levels. One the other hand, 75 percent of Aman rice farmers operate their farms between 90-100 percent efficiency levels. Twenty three percent of the Aman farm operators have TE 70-89 percent. Figure 1 & 2 shows the frequency distribution of technical efficiency scores of Boro and Aman rice.

Table 6: Frequency distribution of technical efficiency scores

Paddy	Efficiency interval	Frequency (no. of farm)	Percentage of farm
Boro	60-69	1	0.67
	70-79	2	1.33
	80-89	8	5.33
	90-100	139	92.67
Aman	60-69	5	2.67
	70-79	16	10.67
	80-89	18	12.00
	90-100	112	74.67

Figure 1: Frequency distribution of technical efficiency scores (Boro rice)

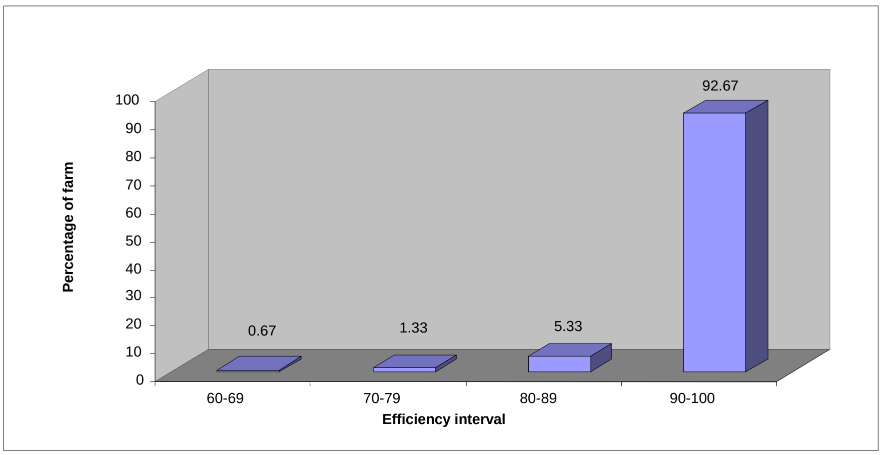
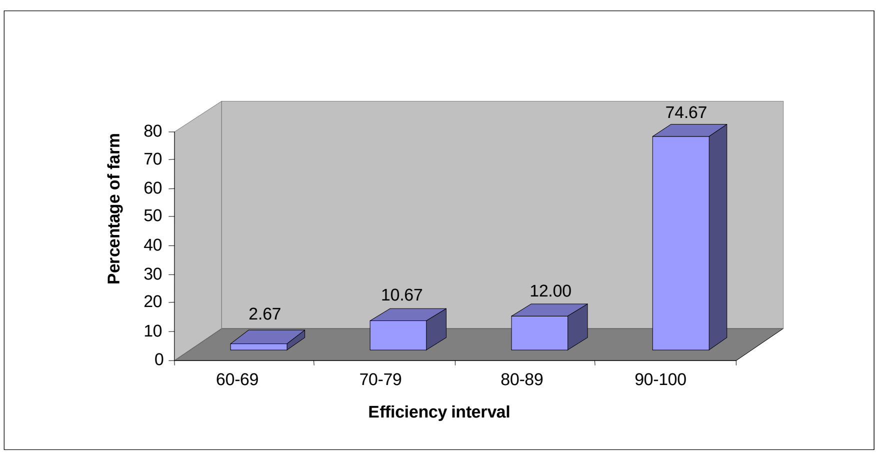


Figure 2: Frequency distribution of technical efficiency scores (Aman rice)



4. Conclusions

Technical efficiency has been estimated using Frontier 4.1 package through Cobb-Douglas form of stochastic frontier production function for the Jamalpur district of Bangladesh. The study has revealed that there is potential for increasing rice production by increasing the levels of farm area, pesticide, power tiller and irrigation cost. But mean technical efficiency of the farmers is 95% for Boro rice and 91% for Aman rice with the existing varieties of rice. That means 5% and 9% technical inefficiency at aggregate level for Boro and Aman. This implies that the output per farm can be increased on an average by 5% for Boro and 9% for Aman rice under prevailing technology without increasing any additional inputs.

The results of TE analysis have indicated no presence of TE has effects on rice production, as depicted by the estimated ‘γ’ parameter which is 0.98 for Boro rice and 0.94 for Aman rice of the model. The TE has been found to range between 0.60 and 0.99 for both (Boro and Aman) rice. About 93 percent farmers operate their farm greater than 90 percent efficiency level in case of Boro rice and 75 percent farmers operate their farm greater than 90 percent efficiency level in case of Aman rice production.

All result revealed that there is no potentiality to increase production with the existing rice varieties to meet the increasing rice demand for increased population. So, new varieties of rice should introduce and disseminate among the farmers. That’s why government as well as agricultural research institutions should give emphasis on rice research to develop new varieties of rice which can help to be food self-sufficient Bangladesh.

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On average technical efficiency of sample rice farmers is 86 percent, which indicates that rice farmers in selected areas can increase the production of rice 14 percent only by managing efficiency level, without increasing input quantities. Hence, it is possible for rice farmers to increase rice output without increasing the level of inputs by using efficient management practices. Technical efficiency analysis of rice farmers in Naogaon district: An application of the stochastic frontier approach. Journal of Economics and Development Studies, 1(1), 1-20.Â Measuring Efficiency of Producing Rice in Bangladesh: A Stochastic Frontier Analysis, Wissenschaftsverlag Vauk Kiel KG in Germany, ISBN 38175-0357-1, pp. 1-215. Technical Efficiency of Boro Rice Production in Jhenaidah District of Bangladesh: A Stochastic Frontier Approach. Article. Full-text available.Â Farm Household Technical Efficiency: A Study on Rice Producers in Selected Areas of Jamalpur District in Bangladesh. Article. Full-text available.Â Efficiency of rice producer is an important factor because of rice is the staple food in Bangladesh.