Agricultural Journal 7 (1): 1-4, 2012
ISSN: 1816-9155

Technical Efficiency of Maize Farmers in Gombi Local Government of Adamawa State, Nigeria

Abba Mohammed Wakili
Department of Agric Education, Federal College of Education, Yola, Nigeria

Abstract: The objective of the study is to determine the technical efficiency of maize farmers in Gombi local government of Adamawa state. Descriptive statistic and Maximum Livelihood Estimate (MLE) using Stochastic Frontier Production Model were used to analyze the data obtained from 120 sample farmers. The data were collected with the aid of a structured questionnaire. The estimated sigma square (σ^2) and gama (γ) are very significant for the maize crop and showed that 84% of the variation in output of maize among the farms was due to the differences in the technical efficiency. The result indicate that the farmers were not fully technically efficient, technical inefficiency scores indicate a mean efficiency ratio of 84% implying that substantial inefficiency exists among the maize farmers in the study area. It was also revealed that the inefficiency effects among the farmers are influenced by farmer's age, education and their farming experience.

Key words: Technical efficiency, stochastic frontier production, estimate, crop, farms, Nigeria

INTRODUCTION

Maize (Zea Mays L.) is one of the most important cereal in the world after rice, millet and sorghum with regard to its production and cultivation (Osagie and Eka, 1998). It constitutes a large percentage of the world's food supply. Maize is an important cereal plant that produces grains used in various forms for the feeding of human beings as well as livestocks because of its high starch (carbohydrates) content and proteins.

The global production of maize is estimated to about 300 million ton. The maize plant can grow on a wide variety of soils ranging from fairly coarse sand to the heaviest clay and in Nigeria, its production is common in all parts of the country with an annual production of about 5.6 million ton (Central Bank of Nigeria, 1992). However, the food problem in Nigeria and indeed maize can be attributed to the level of productivity of resources used, low capitalization, diseases and pest, poor storage facilities and efficiency of resource utilization. This has necessitated the supplementation of domestic supply with large importation of food. The food import bill rose significantly from ₦801,97 million in 1987 to ₦147,301.60 million in 1996. This constitutes a great drain in the country's foreign reserve. In view of the above, understanding the level of production efficiency will play a significant role in establishing developmental strategies that will help improve farmers' ability to increase maize production. The objective of the study is to determine the technical efficiency of maize farmers in Gombi local government area of Adamawa state. A number of studies have attempted to determine the technical efficiency of farmers in developing countries because determining the efficiency status of farmers is very important for policy purposes. Efficiency is also a very important factor of productivity because it is used to assess the economic performance of a farm or organization where resources are scarce and opportunities for new technologies are lacking. Estimate on the extent of inefficiency also help to decide whether to improve efficiency or to develop new technologies to raise agricultural productivity. However, studies by Adedapo (2008) and Amaza and Olayemi (2001) found evidence of technical inefficiency among farmers in the developing countries.

MATERIALS AND METHODS

Study area: The study was conducted in Gombi local government of Adamawa state. Gombi local government is one of the twenty one local government area in Adamawa state. It is created in 1976.

It is potentially rich agriculture and natural resources, it has an estimated land mass of about 17,000 km^2 with a population of 202,272. The vegetation is characterized by tropical climate. Rainfall starts from April and end around September, dry season starts at that period and ends early March. The soil is high loam and good for cultivation of groundnut, sorghum cassava, rice and millet.

Sampling procedure: A multi-stage sampling technique was used. The number of the maize farmers in the local government comprising of five districts areas was obtained from the natural department of the local government area. Three villages were chosen from the five districts and in each village, eight maize farmers were randomly selected. This gives a total of 120 respondents. Primary data were collected with the aid of a well structured questionnaire and personal interview.

Stochastic Production Frontier Model: Given the inherently nature of agricultural production, researchers will use the stochastic frontier production function approach in order to assess the technical efficiency of the maize farmers in Gombi local government area of Adamawa state. The Stochastic Frontier Production Model incorporates a composed error structure with a two sided symmetric component and a one sided component. The one sided component reflects inefficiency while the two sided error captures the random effects outside the control of the production unit including measurement errors and other statistical noise. The model for the cross-sectional data is defined as follows (Aigner *et al.*, 1977; Meeusen and Broeck, 1977; Battese and Coelli, 1988):

$$Y_i = f(X_i\beta)e^{\delta_i} \quad (1)$$

Where:

- Y_i = Output of the ith farmer
- X_i = $(1\times k)$ vector of input quantities used by the ith farmer
- β = $(k\times 1)$ vector of parameters to be estimated
- ε_i = A stochastic error term consisting of two independent components U_i and V_i

$$\varepsilon_i = v_i - u_i \quad (2)$$

The symmetric component V_i accounts for random variations in output due to factors outside the farmer's control such as weather and plant diseases. It is assumed to be independently and identically distributed as $N\approx(0, \sigma_i V^{\prime}2)$ independent of U_i. The asymmetric component U_i is a non-negative random variable, associated with technical inefficiency. It is assumed to be independently distributed with truncation (at zero) of the normal distribution with mean μ_i and variance σ_u^2 [N (μ_i, σ_u^2)]. Under these assumptions the mean of the technical inefficiency effects, μ_i can be specified as follows:

$$U_i = \sum \delta_K Z_{ik} \quad (3)$$

Where:

- Z = $(1\times m)$ vector of observable farm specific variables hypothesized to be associated with technical inefficiency
- δ = $(m\times 1)$ vector of unknown parameters to be estimated

The variance of $\in$ is therefore:

$$\sigma^2 = \sigma_u^2 + \sigma_v^2$$

while the ratio of two standard errors is defined as:

$$\gamma = \frac{\sigma_u^2}{\sigma_v^2}$$

Parameters γ can be determine whether a Stochastic Frontier Model is warranted as opposed to simple production function.

Data Analysis Technique: The stochastic frontier production function was used to analyze the productivity and technical efficiency of maize farmers in Gombi local government area of Adamawa state. The production technology of the farmers was assumed to be specified by the Cob-Douglas frontier production function:

$$\text{Log } Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + (V_i + U_i) \quad (4)$$

Where:

- Log = Natural logarithm
- Y = Quantity of maize (kg)
- X_1 = Land (ha)
- X_2 = Labour (mandays)
- X_3 = Capital (Naira)
- X_4 = Pesticide (L)
- β_0, β_1, β_2 = Regression coefficients
- V_i = Random variables which are assumed to be independent of U_i, identically and normally distributed with zero mean and constant variance N (0, σ_v^2)
- U_i = Which are non negative random variables which are assumed to account for technical inefficiency in production and are often assumed to be independently of V_i such that U_i is non negative truncated (at zero) of half normal distribution with N (0, σ_u^2)

The inefficiency of production, U_i was modeled in terms of the factors that are assumed to affect the efficiency of production of the farmers such factors are related to the socio-economic variables of the farmers. The determinant of technical inefficiency is defined by:

$$U_i = Z_0\delta_0 + Z_1\delta_1 + Z_2\delta_2 + Z_3\delta_3 + Z_4\delta_4 + Z_5\delta_5 \quad (5)$$

Where:

U_i = Technical inefficiency
Z_1 = Age (years)
Z_2 = Education (years)
Z_3 = Farmers' experience (years)
$\delta_0\delta_1$ = inefficiency parameters

These variables are assumed to influence technical efficiency of the farmers. The technical efficiency of an individual farm is defined in terms of the observed output (Y_i) to the corresponding frontier output (Y_i^*) given the available technology. This could be expressed mathematically as:

$$TE = \frac{Y_i}{Y_i^*} \quad (6)$$

Where:

Y_i = The observed output
Y_i^* = The frontier output

Equation 4 can b expand as follows:

$$TE = \frac{Y_i}{Y_i^*} = \frac{Exp(X_i, \beta + V_i - U_i)}{Exp(X_i, \beta + V_i)}$$

So that:

$$0 \le TE \le 1$$

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers: The age distribution of the respondents according to Table 1 shows that most of the farmers 84% are between the ages of 31-40. About 14% are between 20-30 years of age. This shows that majority of the farmers are in their active age of 31-40 years of age. Also, 55% of the respondents are single and 42% are married. This shows that majority of the farmers in the study area are single. On the level of education, 37% of the farmers are illiterates while 32% have formal education.

The years of experience of the farmers in the study area indicate that 50% of the respondents have an average of 21 years experience in maize farming. It is an indication that majority of them have farming experience in maize farming.

Maximum likelihood estimate; the Maximum Likelihood Estimate Method was used to analyze the data and is shown in Table 2. The result shows that the variables included in the model have positive relationship with the output of maize as expected. This implies that an increase in the use of these variables in the production of maize will definitely increase the maize output. All the variables are statistically significant to maize output.

Table 1: Socio-economic characteristics of the respondents

Variables	Frequency	Percentage
Age		
20-30	19	14
31-40	101	84
>41	2	2
Sex		
Male	65	55
Female	55	45
Marital status		
Single	70	42
Married	50	58
Education		
No formal education	45	37
Primary education	38	32
Secondary education	19	16
Tertiary education	18	15
Experience (years)		
<10	20	17
11-20	40	33
>21	60	50

Field study data (2005)

Table 2: Maximum likelihood estimate of Stochastic Cob-Douglas Production Frontier and Technical Inefficiency Model for maize production

Variables	Parameters	Coefficient
Stochastic frontier		
Constant	β_0	2.3761 (0.6070)***
Land	β_1	0.7215 (0.123)***
Labour	β_2	0.0532 (0.0891)*
Capital	β_3	0.0251 (0.022)
Pesticide	β_4	0.0222 (0.010)
Log-likelihood value	211.32	
Mean technical efficiency	84.32	
Sigma square	σ^2	0.0954 (0.312)*
Gama	γ	0.8423 (1.564)***
Inefficiency function		
Constant	δ_0	3.201 (1.424)
Age	δ_1	-0.258 (1.224)
Education	δ_2	-0.171 (0.897)
Experience	δ_3	-0.185 (-0.912)

***Significant at 1%; **Significant at 5%; *Significant at 10%; Computed MLE

The estimated variance of parameters which is the ratio of the performance of farm specific efficiency indices to the total variance of output was 0.842, this implies that 84% of the variation between the observed output and the frontier output is due to the factors within the control of the farmers. The variance of the parameter is significant and statistically different from zero which confirms that there is technical inefficiency in the production of maize in the study area.

The estimated coefficient of the inefficiency function explained the efficiency levels of the farmers. The negative sign of the age variable indicates that increase in age of the farmer decrease inefficiency level of the farmer which means that older farmers are more efficient than the younger farmers. This will mean to say that the older farmers are more familiar with the new technologies in agricultural production than the younger ones. This confirms to the findings of Edet and Sunday (2007) and

Table 3: Distribution of technical efficiency among the farmers

Efficiency class	Frequency	Percentage
0.30-0.39	5	4.17
0.40-0.49	18	15.00
0.50-0.59	20	16.67
0.60-0.69	46	38.33
0.70-0.79	09	7.50
0.80-0.89	11	9.17
0.90-1.00	11	9.17

Field survey, 2005; mean efficiency 84.2%; maximum efficiency 91%; minimum efficiency 25%

Ben-Amor and Muller (2010) whom reported that older farmers are more technically efficient than younger ones. On the other hand, the negative coefficient of education variable of farmers indicates that farmers with high level of education reduces the inefficiency effect thereby implying that farmers with high level of education are more efficient in production process as confirm by Abedullah and Mushtaq (2007) and Ekunwe and Emokaro (2009). Also, the negative effect of farming experience shows that farmers with more experience tend to be efficient than the farmers who are new in the farming activities.

In Table 3, it shows that the best farmers have efficiency score of 91% while the least farmer has technical efficiency of 25%. The mean technical efficiency is 84.2%, this shows that the average farmer in the study area can produce >80% of the potential output from a given mix of production inputs. From the estimation above, it could be seen that the maximum technical efficiency of the farmers is not achieved, it is 15.8% shortfall. This may be attributed properly due to the fact that most of the farmers use traditional mode of cultivation practices.

CONCLUSION

The study examined the level of technical efficiency of maize farmers in the study area using the stochastic production function analysis and maximum likelihood estimate of the Cobb-Douglas production function to estimate the parameters.

The study revealed that 84% of the variation of the farmers output are due to the differences in their technically efficient thereby giving room for 15.8% for increased in production of the crop using available production input and technology. Also, the farmer's technical efficiency has been shown to be significantly influenced by the socio-economic characteristic of the farmer such as age, farming experienced and level of education. Therefore, improvement on the farmer' level of education through adult education by the government will definitely improve his productivity and raise his income. The supply of production input on the other hand has to be done at the right time and at affordable price so that, the farmers can have access to the inputs for early agricultural practices.

REFERENCES

Abedullah, S.K. and K. Mushtaq, 2007. Analysis of technical efficiency of rice production in Punjab(Pakistan). Implication for future investment strategies. Pak. Econ. Soc. Rev., 45 : 231-244.

Adedapo, K.D., 2008. Technical efficiency of maize farmers in Ogbomoso Agricultural Zone of Oyo State. Int. J. Agric. Econ. Rural Dev., 1: 102-107.

Aigner, D., C.A.K. Lovell and P. Schmidt, 1977. Formulation and estimation of stochastic frontier production models. J. Econ., 6: 21-37.

Amaza, P.S. and J.K. Olayemi, 2001. Technical efficiency in food crop production in Gombe State, Nigeria. Niger. Agric. J., 32: 140-151.

Battese, G. and T. Coelli, 1988. Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. J. Econ., 28: 387-399.

Ben-Amor, T. and C. Muller, 2010. Application of stochastic production frontier in the estimation of technical efficiency of irrigated agriculture in tunisia. Agric. J., 5: 50-56.

Central Bank of Nigeria, 1992. Annual report and statement of accounts. Central Bank of Nigeria, Lagos, Nigeria.

Edet, J.U. and B.A. Sunday, 2007. Measuring technical efficiency of water leaf (*Talinum triangulare*) production in Akwa Ibom State, Nigeria. Am. Eurasian J. Agric. Environ. Sc., 2: 518-522.

Ekunwe, P.A. and C.O. Emokaro, 2009. Technical efficiency of catfish farmers in Kaduna, Nigeria. J. Applied Sci. Res., 5: 802-805.

Meeusen, W. and V.D. Broeck, 1977. Efficiency estimates from Cobb-Douglas production function with composed error. Int. Econ. Rev., 18: 435-444.

Osagie, A.U. and O.U. Eka, 1998. Nutritional Quality of Plant Foods. Postharvest Research Unit, University of Benin, Benin City, Nigeria, ISBN-13: 9782120022, Pages: 279.