IJAERD E-Journal International Journal of Agricultural Economics & Rural Development - 1 (2): 2008

Technical Efficiency of Maize Farmers in Ogbomoso Agricultural Zone of Oyo State

Adedapo, K. D
Department of Agricultural Economics and Extension,
Ladoke Akintola University of Technology, Ogbomoso – Nigeria
e-mail: akolawoledaud@yahoo.com

Abstract: The objective of the study is to determine the technical efficiency of maize farmers in Ogbomoso agricultural zone of Oyo state Agriculture Development Programme (OYSADEP) .Descriptive statistics and Maximum Likelihood Estimate (MLE) using stochastic frontier production model were used to analyze the data obtained from one hundred and twenty (120) sampled farmers. The result of the maximum likelihood estimate (MLE) showed that 52% of the variation in output of maize among the farms was due to technical inefficiency. The technical inefficiency index computed shows a mean efficiency ratio of 0.763 implying that substantial inefficency exists among the maize farmers in the study area. It was concluded that the farmers in the study area were technically inefficient.

Keywords: Technical efficiency, maize, small-scale farmers

INTRODUCTION

Maize (zea mays L.) is a cereal crop of *Graminae* family which is cultivated for their seeds (grains). It constitutes a large percentage of the world's food supply. Maize is important in the feeding of human being and livestock because they have high starch (carbohydrate) content and varying amount of proteins and seeds can be dried to low moisture content. (Komolafe and Adegbola, 1978).

Maize is one of the most useful crops ever grown in history. It can be boiled or roasted or made into a paste eaten by adult and children. It can also be used to make "*abodo*" and "*elekute*" in Nigeria and "*kenke*" and "*akpele*" in Ghana.

Fried maize is also good in making popular refreshment called "*guguru*" or pop corn. This is eaten all over the world. Industrial use of maize includes the production of breakfast cereals like custard, cornflakes, corn oil, glucose, starch and alcohol (Komolafe and Adegbola, 1978).

The food problem in Nigeria has been exacerbated by the level of productivity of resources used in recent time. This has necessitated the supplementation of domestic supply with large importation of food. The food import bill rose significantly from N 801.97 million in 1987 to N 147,301.60 million in 1996 (FOS,1997). This constitutes a great drain on the country's foreign reserve. Also, a country that depends heavily on food importation from other countries can not be said to be truly independent. This is because food importation may constitute a drain on the country's foreign reserves and at times the importing country can be held to ransom in critical times, especially when there is policy change (e.g. export restriction) or unforeseen circumstances in the exporting country.

The objective of this paper is to determine the technical efficiency of maize farmers in the Agricultural Development

Programme (ADP) zone of Ogbomoso. Determination of input-output relationship for any particular economic activity is important, at least for three reasons. The estimated parameters of the production function will show the

i. Elastic of output with respect to particular input
ii. Elastic of output with respect to a proportional change in all inputs and
iii. Elasticity of substitution between inputs

Furthermore, the main concern of any economic activity is to achieve the maximum possible by transforming a set of given input into some output defined by the production function. It has been the general consensus that in the developing countries, farmers do not exploit resources fully. (Bathese and Coelli, 1995)

The concept of technical efficiency can be clearly understood by referring to figure 1. In figure 1, the curve YM shows the maximum possible total output (at the frontier) as input X increased, while the curve YA shows the input response in an average farm.

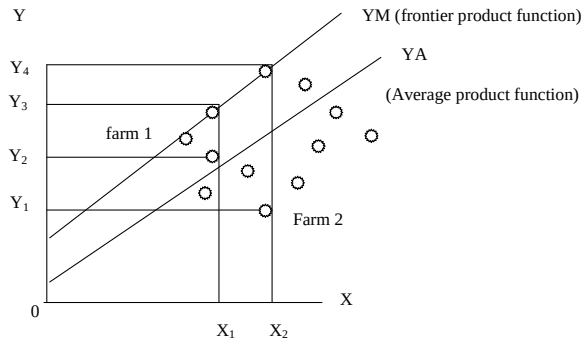

Figure 1: Technical efficiency

The technical inefficiency is given by Y_2 / Y_3 for a given input level X_1 farm. For farm 2 technical i.e. inefficiency is given Y_1 / Y_4 using input X_2.

Numerous 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 growth in an economy where resources are scarce and opportunities for new technologies are lacking, inefficiency studies will be able to show that it is possible to raise productivity by improving efficiency without increasing the resource base or developing new technology. Estimate on the extent of inefficiency also help to decide whether to improve efficiency or to develop new technologies to raise agricultural productivity.

According to Yao and Liu (1998), for efficient farmers, government can expedite development by emphasizing new investment or technologies rather than extension and education efforts which were aimed at less efficient farmers.

Nevertheless, studies by Alimi (2000), Ayanwale (1995) and Jandrow *et al* (1982) found evidence of technical inefficiency among farmers in the developing countries.

METHODOLOGY

The study was carried out in Ogbomoso agricultural zone. This comprises of five (5) local government areas. These are Ogbomoso North, Ogbomoso South, Ogo-Oluwa, Orire and Surulere local government areas. The population for the study are the ADP maize farmers in the study area. The zone experience both wet and dry season annually. The climate of the area favours maize production. The rainy season usually starts in March and last till November. The dry season is usually very hot except during harmattan period when it is cold and dry. Majority of the populace combines subsistence farming with other

occupation like trading and civil service (school teachers)

A multi-stage sampling technique was used. A list of all the maize farmers in all the five local government areas was obtained from the ADP zonal headquarters in Ogbomoso. From the lists 3 villages were randomly selected from each of the five local government areas and from each of the 3 villages, 8 maize farmers were selected. This gives a total of 120 respondents.

Method of data analysis - A combination of descriptive and stochastic production function model using the method of Maximum Likelihood Estimate (MLE) with computer programme FRONTIER version 4.1 (Coelli, 1994) were used to analyze the data obtained from the farmers. Descriptive tools (percentages and frequency) were used to analyze the socio-economic characteristics of the farmers while Maximum Likelihood Estimate (MLE) was used to analyze the technical efficiency of the farmers.

The model is expressed as

$$Y_i = \exp\ (X_i\beta + V_i - U_i)$$

…… (1)

The technical efficiency of production of the ith farmer in the appropriate data set, given the level of these inputs, is defined by

$$TE_i = \exp(-V_i) = Z_i\sigma$$

…… (2)

From equations (1) and (2), the random factor (v) is independently and identically distributed with N (O, σ2v) while the technical inefficiency effects U is often assumed to have a half normal distribution /N (O, σ 2 v).

The farm specific technical efficiency (TE) of the ith farmer was estimated by using the expectation of vi condition on the random variable (Ei) as shown by Battese and Coelli (1995). The TE of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output given the available technology, that is;

$$TE = Y_i = \frac{\exp(X_i\beta + V_i - U_i)}{esp(X_i\beta + V_i)}$$

$$Y_i* = \exp(-U_i)$$ …..…… (3)

(Tadesse and Krishnamurthy, 1997)

So that 0 < TE < 1 i.e. technical efficiency is between 0 and 1)

In the study area, a separate stochastic frontier production proposed by Bathese and Coelli (1995) was applied in the analysis of data to capture the efficiency of ADP maize farmers. The empirical model of the stochastic production frontier is specified as

$$\ln Yij = \beta_0 + \beta_1 \ln X_1 ij + \beta_2 \ln X_2 ij + \beta_{3j} \ln X_3 ij + \beta_4 \ln X_4 ij + \beta_5 \ln X_5 ij + \beta_6 \ln X_6 ij + Vij - Ui$$

…… (4)

Y – Maize output in Kg

Y_1 - Total quantity of seed used (Kg)

Y_2 - Total quantity of labour used (Mandays)

Y_3 – Cost of transportation (Naira)

Y_4 – Quantity of herbicides used (Kg)

Y_5 – Quantity of fertilizer used (Kg)

Y_6 – Cost of farm implement

Vij – is a random error term independently and identically distributed (have a normal distribution with mean zero and variance σ 2 v) intend to capture event beyond the control of farmers.

Uij – is non-negative random variable called technical inefficiency effects associated with

technical efficiency of production of farmers involved.

In- is the natural logarithms (to base e).

RESULTS AND DISCUSSION

Socio- economics characteristic of the farmers

The age distribution of the respondents according to Table 1 shows that most of the farmers (32%) are between 40 and 49 years of age. About 29% are between 30 and 39 years while 23% are between 50 and 59 years of age. The mean age of the respondent is 42.50% years. This shows that the farmers are still in their active age. Majority of the farmers are male (83.3%). While only 16.7% are female. Also from Table 1, 88% of the respondent are married while only 8.3% are single, 2% each are divorced or widowed. This shows that majority of the respondents are married men and women. On the level of education, majority of the respondents are literate while only 25% have no formal education.

The mean year of experience of the maize farmer in the study area is 11year. This shows that maize production has been in existence long ago as majority of the farmers (about 86%) have been in maize production for about 20 years. The mean household size of the respondent is about 7. This shows that farmers can have easy access to additional labour from the family members.

Table 1: Socioeconomics Characteristics of the Respondents

Variables	Frequency	Percentage
Age (years)		
≤ 29	12	10
30-39	36	29
40-49	38	31.5
50-59	28	23
≥ 60	6	6.5
Sex		
Male	100	83.3
Female	20	16.7
Marital status		
Single	10	8.3
Married	106	88.3
Divorced	2	1.7
Widowed	2	1.7
Education		
No Formal Education	30	25
Primary Education	42	35
Secondary Education	32	26.7
Tertiary Education	16	13.3
Experience (years)		
≤ 10	86	71.7
11-20	1.8	14.7
21-30	8	6.8
31-40	8	6.8
Household size		
1-5	72	60
6-10	38	31.6
11-15	10	8.4

Source: computer from field survey data, (2007)

Result of Ordinary least square estimate

- The OLS method was used to analyze the data. The result shows that quantity of seed, labour, transportation, herbicides, fertiliser and other cost were significant at 1% level. The coefficient of labour and herbicide have negative signs, which implies that an increase in the use of these inputs leads to a decrease in the level of maize production and the technical efficiency of the farmers. Other variables with positive co efficiency imply that they contribute positively to the productivity of maize in the zone. The quantity of these inputs should be increased in order to increase the technical efficiency as well as the productivity of maize farmers.

$$Y = 0.817 + 0.601\log X_1 - 0.121\log X_2 + 0.132X_3 - 0.116\log X_4 + 0.143\log X_5 + 0.10\log X_6$$
(0.629) (0.680)* (0.112) (0.619)* (0.119)* (0.129)* (0.139)

Maximum Likelihood Estimate (MLE) Result- The maximum likelihood estimate (MLE) of the parameters result is presented in Table 2. It shows the efficiency in the use of the available resources and technology. Four of the explanatory variables included in the model have positive relationship with the output of maize while only two variables, labour and herbicides have negative relationship with maize output. This implies that an increase in the use of these variable decrease maize output. All the variables are significant to maize output. This corroborates the result of the OLS

The estimated variance of parameters which is the ratio of the performance of farm specific efficiency indices to the total variance of output was 0.524. This implies that 52% of the variation between the observed output and the frontier output are due to technical inefficiency. In essence, the shortfall observed in output from the frontier output is due primarily to 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.

Table 2 – Frontier Analysis Result

Variable	OLS Estimate	Frontier estimate
Constant	0.817 (0.629)	0.925 (0.94)
Quantity of seeds (X_1)	0.601 (0.68)	0.609 (0.96)
Labour (X_2)	-0.121 (0.112)	0.41 (0.99)
Transport (x_3)	0.135 (0.619)	0.14 (0.91)
Herbicides (X_4)	-0.116 (0.119)	-0.12 (0.99)
Fertiliser (X_5)	- 0.143 (0.124)	-0.14 (0.98)
Other cost (X_6)	0.109 (0.139)	0.11 (0.99)
Log likelihood function		-0.607
Sigma- square		0.408
Gamma a		0.524

Source: Computed from field survey data, 2007
The value in parenthesis is the T ratio
* Significant at 1% level

Technical efficiency distribution

In Table 3, the technical efficiency index is presented using Jondrow *et al* (1982) procedure. The minimum estimated efficiency is 30% while the maximum efficiency is 92.5% and the mean level of technical efficiency is 76.3%. According to Grabowski *et al* (1990) a farm is considered technically inefficient even if the farm register a technical efficiency index of 82%. Going by this standard the number of maize farmers considered efficient technically is less than 15% of the total maize farmers in the sample under study. This indicates that maize farmers can increase their productivity by raising the technical efficiency through increased input usage.

Table 3: Technical Efficiency Distribution.

Efficiency index	Frequency	Percentage
0.30 – 0.39	4	3.33
0.40 – 0.49	20	16.67
0.50 – 0.59	22	18.33
0.60 – 0.69	48	40.00
0.70 -0.79	08	6.67
0.80 – 0.89	10	8.33
0.9 – 1.00	08	6.67
Total	120	100.0

Source: computed from field survey data, 2007
Mean efficiency = 76.3%
Maximum efficiency = 92.6%
Minimum efficiency = 30%

CONCLUSION

The study examined the technical efficiency of ADP maize farmers in Ogbomoso agricultural zone of Oyo state. Maximum likelihood estimation procedure was used to analyse the data obtained from the sampled farmers to derive the frontier production function. The technical efficiency index computed indicated strongly that most of the maize farmers in the

study area are highly technical inefficient with a mean efficiency ration of 0.763. This shows that great potential exists for the farmers to further increase output using the available inputs and technology

Conclusively, the research findings show that there is a big scope to increase technical efficiency of the farmers with the existing level of inputs. This implies that the technical efficiency can be increased substantially with extension services with all necessary technical assistance for the dissemination of timely information to farmers and to relay their problems to researchers for solution. This will go a long way to increase the level of technical efficiency and output of the maize farmers.

Therefore effort should be directed in education, extension services, credit facilities for the purchase of necessary input(seed, fertiliser and herbicide) as well as other support services in order to improve the technical efficiency of the maize farmers in Ogbomoso agricultural zone of Oyo state.

REFERENCES

Alimi: T (2000) "Resources use – efficiency in food crop production in Oyo state of Nigeria" Journal of Agriculture and Environments 1(1): 1-7

Ayanwale, A.B. (1995): "Resources – use Efficiency in cassava processing in Oyo North Area of Oyo stat, Nigeria" Ife journal of Agriculture 16 and 17: 123 - 135

Belbese, K and R. Grabowski (1985). Technical efficiency in Nepalese Agriculture" Journal of Development Areas, 19 (4) : 515- 526

Bethese G.E and T.J Coelli 1995). "Prediction of firm level of Technical Efficiency with Generalized frontier Production and panel Data. Journal of Economics 28:387 – 399

Coellli; T.J (1994) " A guide to frontier version 4.1: A computer for stochastic frontier production function and cost function estimation". Unpublished paper, Department of Economics, University of New England, Armidala NSW 2351; Australia pp 32-38

FOS 1997: "Review of the Nigeria Economics". Publication of the office of statistics. (FOS) July 1997

Jondrow, J., Lovell, CAK., Materou, I.S and P. Sehmidt, 91982) "The estimate of technical inefficiency in the stochastic frontier production function model. Journal of economics 19:269-294

Komolafe A.F and A.A Adegbola (1978) "Agricultural Science for West African Schools". 78p.

Tadesse B. and S. Krishnamurthy (1997). "Technical efficiency in paddy farms of Tamil Nadus. An analysis based on farm and ecological zone". Journal of Agricultural Economics 16: 185-192

Yao; S. and Liu Z. (1998) " Determinants of grain production and technical Efficiency in China" Journal of Agricultural Economics 49 (2) : 171 -184