

Determinant of Maize Production among Maize Farmers in Ogbomoso South Local Government in Oyo State

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Abstract: Agriculture has been observed to be one of the major sources of income to the Nigerian's farmers, but there is a problem militating against increase and sustainable farm income. The research therefore, undertakes the determinant of maize production among maize farmers in Ogbomoso South LGA in Ogbomoso Agricultural zone of Oyo state. A multistage sampling technique was used to select 30 farmers in the study area. The study used a stochastic frontier production model to estimate the efficiency of the farmers; the empirical results revealed that seed was positive and statistically significant at 1% level in the study area. The estimated gamma (γ) parameter of 0.13 in the study area, indicates that 13% of the total variation in maize output is due to the technical inefficiencies in the study. The mean technical efficiency (χ) was 0.843 in the LGA while, the Return To Scale (RTS) was 2.773 in the study. It was therefore, concluded that there is a positive and significant relationship between farm size, quality of seed used and maize output in the study.

Key words: Productivity, technical efficiency, maize determinant, Ogbomoso South, stochastic production frontier, farm size

INTRODUCTION

Recently, the bulk of maize grains produced in Nigeria were from the Southwest zone. Although, large proportion of the green maize is still produced in all the Southwestern part of the country, there has been dramatic shift of dry grain production to the savanna, especially the Northern Guinea savanna. This can now be regarded as the maize belt of Nigeria; in this zone farmers tend to prefer maize cultivation to other grain species. This trend may have been brought about for several reasons including availability of streak resistant varieties, high-yielding hybrid varieties, increase in maize demand coupled with the federal government imposed ban on importation of rice, maize and wheat. Local production had to be geared up to meet the demand for direct human consumption, breweries, baby cereals, livestock feeds and other industries (Iken and Amusa, 2004).

The importance of sustaining agricultural production to improve standard has been recognised by all countries throughout the world. However, in the economic literature of the 1950s and 1960s the role of agriculture in development was considered ancillary to that of the modern industrial sector where most of the accumulation and growth was expected to take place. Subsequent theoretical investigations and the very disappointing

performance of agriculture in many developing countries have led to the belief that the role of agriculture in development should be re-examined. Erratic and in-egalitarian growth persistence of malnutrition, periodic famines together with increased food dependence from abroad have continued. The situation is however, substantially worse than highlighted by these trends. Indeed, the initial conditions from which low growth has taken place were already quite distressing. Average per capita food supply was conspicuously lower than requirement, while food consumption was traditionally much skewed. Recent investigations have shown that such inequality would appear to have increased even in countries experiencing relatively rapid agricultural growth. Thus, the combined effects of low starting points, slow or negative growth of food output per capital and the worsening of income distribution and food consumption explain the increase in the number of people suffering from deficient food intake and why the food threat continues to hang over many developing countries.

Nowadays, there is a large consensus on the need for increasing agricultural output and improving nutritional standards. However, views and policies differ widely on how to attain such objectives. A large number of strategies have been proposed ranging from the technology option, which stresses the increased use of

modern machinery, pesticides and fertilizers, to others which consider that the existing economic and power structure in agriculture is the major obstacle to rural development. According to the latter view, the provision of more and improved inputs, although, necessary would not be sufficient to ensure a fast and egalitarian growth capable of eliminating rural poverty. The increase in input supply should be accompanied by measures ensuring broadly equal access to land and other productive assets to the rural population; this could be achieved through land redistribution.

The main objective of this research is to analyze the determinant of maize production among maize farmers in Ogbomoso South Local Government in Oyo State.

The specific objectives are to:

- Determine the technical efficiency of maize production in the study area
- Examine the determinants of maize output in the study area

Hypothesis of the study

Null Hypothesis (H_0)

H₁: There is no significant relationship between farm size and maize output.

H₂: There is no significant relationship between the quality of seed used and maize output.

Concept of efficiency and production: Efficiency is the act of achieving good result with little waste of effort. It is the act of harnessing material and human resources and coordinating these resources to achieve better management goal. Farrell (1957) distinguished between types of efficiency: Technical Efficiency (TE), Allocative Efficiency (AE) and Economic Efficiency (ER), by saying that farm efficiency can be measured in terms of all these type of efficiency. The appropriate measure of technical efficiency is input saving, which gives the maximum rate at which the use of all the inputs can be reduced without reducing output. Technical efficiency is defined as the ability to achieve a higher level of output, given similar levels of inputs. Allocative efficiency deals with the extent to which farmers make efficiency decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost. Technical and allocative efficiencies are components of economic efficiency (Abdulai and Huffman, 2000).

Production is defined as the transformation of goods and services into finished products (that is input-output relationship) and this is also applied to every production process, maize production inclusive. Olayide and Heady (1982) define production process as one whereby some

goods and services called inputs are transformed into other goods and services called output. In agriculture, the physical inputs, which we use are: land, labor, capital and management. Pitt and Lee (1981) have estimated stochastic frontiers and predicted firm-level efficiencies using these estimated functions and then regressed the predicted efficiencies upon firm-specific variables such as managerial experience, ownership characteristics etc. in an attempt to identify some of the reasons for differences in predicted efficiencies between firms in an industry. This has long been recognized as useful exercises, but the two-stage estimation procedure has also been long recognized as one, which is inconsistent in its assumptions regarding the independence of the inefficiency effects in two estimation stages. The two-stage estimation procedure is unlikely to provide estimates, which are as efficient as those that could be obtained using a single stage estimation procedure.

Stochastic frontier production function: Empirical estimation of efficiency is normally done with the methodology of stochastic frontier production function. The stochastic frontier production model has the advantage of allowing simultaneous estimation of individual technical and allocative efficiencies of the farmers as well as the determinants of technical efficiency (Battese and Coelli, 1995). Economic application of stochastic frontier model for efficiency analysis include Aigner *et al.* (1977) in which the model was applied to US agricultural data, Battese and Corra (1977) applied the technique in the pastoral zone of Eastern Australia, Ogundari and Ojo (2005), Ajibefun *et al.* (2002), Bravo-Ureta and Pinheiro (1993) and Ali and Byerlee (1991) in which, they offer comprehensive review of the application of the stochastic frontier model in measuring the technical and economic efficiencies of agricultural producers in developing countries. Karl and Victor (1990) technical efficiency is the ability of the firm to produce the maximum output from its resources. One firm is more technically efficient if it produces a level of output higher than another firm with the same level of input usage and technology. Measures of technical efficiency give an indication of the potential gains in output if inefficiencies in production were to be eliminated. Recent measures of technical efficiency in the Soviet Union have been incongruous with the presumption that bureaucratic obstacles in the command-economy system inherently foster waste in resource utilization and inefficiencies in production also quoted Koopmans (1951) in his analysis of time-series data of aggregate Soviet Republic agricultural production, estimated that the average level of technical efficiency in Soviet Agriculture is almost 95%, with little variability among the republics.

Technical efficiency was also defined by Koopmans (1951), as the ability of a farm to maximize output for a given set of resource inputs while, allocative (factor price) efficiency reflects the ability of the farm to use the inputs in optimal proportions given their respective prices and production technology. The ideas of production function can be illustrated with a farm using n inputs: X_1, X_2, \dots, X_n , to produce output Y . Efficient transformation of inputs into output is characterized by the production function $f(X_i)$, which shows the maximum output obtainable from various inputs used in production. Therefore, for the sake of this study, the stochastic frontier production function in which Cobb-Douglas was proposed by Battese and Coelli (1995) and confirmed by Yao and Liu (1998) represents the best functional form of the production frontier and was used for data analysis in order to better estimate the inefficiency of the maize farmers in this study.

MATERIALS AND METHODS

The study area: The study was carried out in Ogbomoso South Local Government area in Ogbomoso Agricultural zone of Oyo state; this LGA comprises of different villages, which are rural in nature. Ogbomoso is located approximately on the intersection of latitude $8^{\circ}08'N$ and longitude $4^{\circ}15'E$. It is about 105 km North East of Ibadan (State capital), 58 km North West of Osogbo, 53 km South West of Ilorin and 57 km North East of Oyo town. Ogbomoso is regarded as a derived Savannah vegetation zone and a low land rain-forest area.

Sampling procedure: Maize farmers are the respondents for this study; 40 maize farmers were selected from the local government, but only 30 was used for the study.

The sampling technique employed is a multistage stratified random sampling technique. The first stage involved purposive selection of the rural areas such as, Antorun, Ibapon, Atoba, Owolake and Pontela Olode, respectively. The second stage involved simple random sampling through random selection of 40 maize farmers in the study area.

Research instrument: Questionnaire and interview schedule were the research instruments used for this study to collect information from the farmers.

Data analysis: The data obtained from the field were subjected to analysis using inferential statistics, which was used to test the hypothesis. The Stochastic frontier production model was used to determine the relationship between the dependent variable (maize output) and the

independent variables as well as to determine the technical efficiency in farmers operation in the study area.

Model specification:

$$Y = f(X_1, X_2, \dots, X_n) \quad (1)$$

where:

- Y = Output, value of total maize produced (kg)
- X_1 = Farm size (ha)
- X_2 = Family labor (man day)
- X_3 = Hired labor (man day)
- X_4 = Seeds (kg)
- X_5 = Fertilizer (kg)

The stochastic frontier production model

Linear function:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \mu + v \quad (2)$$

Cobb-Douglas production frontier function:

$$\ln Y = \ln A + \sum_{i=1}^5 \beta_i \ln X_i + V - U \quad (3)$$

$$\ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + \mu + v \quad (4)$$

Inefficiency model:

$$U_i = \delta_0 + \sum \delta_i Z_i \quad (5)$$

$$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} \quad (6)$$

where:

- Z_1 = Level of education
- Z_2 = Years of farming (year)
- Z_3 = Family size (number)
- Z_4 = Land right (dummy, with land right = 1, without land right = 0)
- Y = Dependent variable
- X 's = Independent variables
- μ and v = Error term
- b_i 's = Parametric estimates
- b_0 's = The intercept term
- A and B_i = Parameters to be estimated ($i = 1, 2, \dots, 5$)
- X_i = The vector of (transformations of the) i th input used by j th farm
- β = A vector of unknown parameters and
- V = Random variables
- U = Non-negative random variables, which are assumed to account for technical inefficiency in production
- δ_0 and δ_i = Parameters to be estimated ($i = 1, 2, \dots, 4$) together with the variance parameter

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

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

$$\lambda = \sigma_u / \sigma_v$$

$$\gamma = \sigma_u^2 / \sigma_v^2$$

This measures the effect of technical efficiency variation of observed output.

$\gamma > 1$ indicates that one-sided error dominates the symmetry error indicating a good fit and correctness of the specified distribution and assumption.

On the assumption that V_i and U_i are independent and normally distributed, the parameters β , σ_u^2 , σ_v^2 , σ^2 , γ and λ were estimated by the method of Maximum Likelihood Estimates (MLE), using the computer FRONTIER version 4.1 (Coelli, 1996), which also computed the estimates of technical efficiency.

RESULTS AND DISCUSSION

Estimates of the stochastic frontier function

Estimated production function: The Cobb Douglas production function was adopted for this result compared to the Ordinary Least Square (OLS) functional form because of the higher number of significant variables and it also caters for both increasing and decreasing returns to scale unlike the linear functional form which considers only the constant returns to scale, which rarely exist in agricultural production activities.

The parameters and related statistical test results obtained from the stochastic frontier production function analysis are presented in Table 1. There is a positive and significant relationship between farm size and maize output in this local government area. Land is therefore, a significant factor associated with changes in output in this area. Hired labor is found to be a significant factor influencing changes in maize output in the study area; however, it is negative and significant. This implies that the more the hired labor that is been employed, the maize output will be reduced by 0.149 due to a 1 unit increase in labor hired.

The coefficient of seeds is positive and statistically significant in the study area. This implies that seed is a positive factor influencing maize output in the study. In other words, the more the quality (variety) of seeds used in kg, the more the output of maize produced.

Sources of inefficiency: The sources of inefficiency were examined using the estimated (δ) coefficients associated with the inefficiency effects in Table 1, the inefficiency effects are specified as those relating to education, experience, family size and land right.

Table 1: OLS result of the frontier estimates for the study area

Variables	Parameters	Coefficient	t-ratio
Constant	β_0	1.998	0.917
Farm size	β_1	0.426**	1.936
Family labor	β_2	-0.004	-0.716
Hired labor	β_3	-0.135	-1.213
Seeds	β_4	0.622***	5.468
Fertilizer	β_5	-0.983	-0.804
MLE result of the frontier estimates for the study area			
Constant	β_0	3.379	2.442
Farm size	β_1	0.609*	4.102
Family labor	β_2	-0.023	-0.401
Hired labor	β_3	-0.149*	-3.013
Seeds	β_4	0.653***	7.122
Fertilizer	β_5	1.683	2.108
Inefficiency model			
Level of education	δ_1	0.042	0.802
Years of farming	δ_2	0.050**	2.192
Family size	δ_3	-0.091*	-1.769
Land right	δ_4	-0.109	-1.121
RTS	-	2.773	-
Sigma squared	σ^2	0.014***	3.078
Gamma	γ	0.13	0.330
Mean efficiency	λ	0.843	-
Log likelihood function	-	19.877	-

*: 10% level; **: 5%; ***: 1%. Result from data analysis, 2007; NB: if the estimate for the γ (gamma) parameter in the stochastic frontier production function is quite large, which means that the inefficiency effects are highly significant in the analysis of the value of output of the maize farmers

The estimated coefficient of education is appropriately signed in this study and statistically significant. The implication is that farmers with more years of formal education tend to be more technically efficient in maize production, presumably, due to their enhanced ability to acquire technical knowledge, which makes them closer to the frontier output.

The estimated coefficient of farming experience is positive and statistically significant at 5% in this study. The positive coefficient indicates that farmers with more years of farming experience are relatively less technically efficient or more inefficient in maize production (Table 2).

The estimated coefficient of family size is negative and statistically significant in the study. This implies that maize farmers with more family size tend to be more technically efficient in maize production in this study area.

Return to scale: The Return To Scale (RTS) was 2.773 in this study, indicates a positive increasing return to scale, which implies that maize production was in stage 1 of the production surface.

This shows that effort should be made to expand the present scope of production to actualize the potential in it. That is more of the variable inputs should be employed to achieve more output.

The diagnostic statistics: The estimated sigma square (σ^2) in this study area (0.014) is significant different from zero at 1%. This indicates that one sided error term dominates the symmetry error indicating a good fit and the

correctness of the specified distributional assumptions. Therefore, if γ is statistically different from zero implies that traditional average (OLS) function is not an adequate representation for the analysis.

The determinants of technical efficiency: The determinants of technical efficiency of the maize farmers in the study area include farm size, hired labor and seed. The implication is that the variables greatly impact on the TE of the maize farmers in the Local Government, which means that the tendency for any maize farmers to increase his productions depend on the amount of farm size and seed available to him, the farm size and the seeds are significant at various level in the study therefore, they are a significant factors of production in the study area. This implies that the more the land is open for production and the more the quality seed used the more the maize output.

Gamma (γ) parameter: The estimated gamma (γ) parameter of 0.13 in the study area indicates that 13% of the total variation in maize output is due to the technical inefficiencies in the Local Government Area.

Technical efficiency for the study area: In the local government, the predicted technical efficiencies differ substantially among the maize farmers; ranking from 0.662 and 0.995 with the mean technical efficiency estimated to be 0.843, a frequency distribution of the technical efficiencies is presented in Table 1 and Fig. 1.

This shows that the highest numbers of farmers have technical efficiencies of 0.9 and above; this also indicated that there is a wider distribution of technical efficiencies among the maize farmers in the area, which revealed that there is a considerable room for effecting improvements in the technical efficiencies of the farmers in the local government (Table 2).

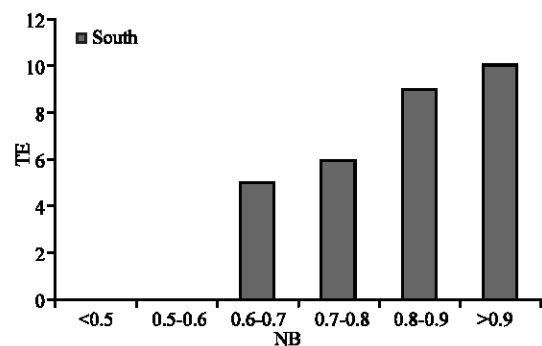


Fig. 1: Graph showing decile range of farmers in the study area. Result from data analysis, 2007

Table 2: The frequency and decile range of farmers' efficiency

Range	Frequency	Percentage
<0.5	0	0.0
0.5-0.6	0	0.0
0.6-0.7	5	16.7
0.7-0.8	6	20.0
0.8-0.9	9	30.0
>0.9	10	33.3
Total	30	100.0

Result from data analysis, 2007

Therefore, there is scope for increasing maize production in this local government by 15.7% with the present technology.

CONCLUSION

The study examines the determinant of maize production among maize farmers in Ogbomosho South LG in of Oyo state. A multistage sampling technique was used to select 30 farmers in the study area. Data were collected and subjected to inferential statistics (OLS) and the stochastic frontier production model, which was used to determine the relationship between the dependent variable (maize output), the independent variables and the technical inefficiency in farmers operation in the study.

The regression results revealed that farm size was statistically significant at 10% level while seed was positively and statistically significant at 1% level in the local government area. The estimated gamma (γ) parameter of 0.13 in the study area, indicates that 13% of the total variation in maize output is due to the technical inefficiencies in the study. The mean technical efficiency (χ) was 0.843 and the Return To Scale (RTS) was 2.773 in the area.

It can therefore, be concluded that there is a positive and significant relationship between farm size, quality of seed used and maize output in the study area.

Therefore, the null hypothesis was rejected and also availability and access to quality seed have positive impact on output and increase in size of production resulting in better output. The maize farmers were fairly efficient in the use of input resources.

RECOMMENDATIONS

Based on the findings in the study area, the following are recommended:

- Agricultural societies should be encouraged in the rural areas in order to cater for the agricultural needs of small scale farmers
- Farmers need to organize themselves into groups for easy access to formal sources of credit to acquire the needed farm implements, quality seeds etc.

- Also more efforts should be intensified on the part of extension agents in educating the farmers so as to boost their efficiencies in maize production
- Results of better researches of improved agronomic practices should be extended to the farmers by the extension agents
- The study confirmed that more land can still be open for maize production in the study area with the current labor size

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