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Technical Efficiency and Constraints among Medium Scale Maize Production in Oyo State, Nigeria

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Abstract
This study presents the empirical analysis of the constraints and determinants of technical efficiency in medium – scale maize production in Oyo state, Nigeria. Primary data were collected on 76 medium scale maize farmers selected from some major maize producing agricultural area Afijio L. G. A. in Oyo state Nigeria. The selection of respondents was multi – staged and involved random sampling as well as purposive sampling methods. Mean and standard deviation were used to analyze the constraints on maize production while translog stochastic frontier model was used to estimate the determinants of technical efficiency of the farmers. The major constraints on maize production as perceived by medium – scale farmers among others was inadequate processing facilities (39.5%) and lack of mechanical services (25.0%). The average technical efficiency about 75%. The determinants of technical efficiency which were statistically significant were sex, age and experience, sex and age had an inverse relationship with technical inefficiencies of farmers while experience had a direct relationship. Hence, Nigeria, public and private policies that would improve the farmers' experience in maize production especially in handing the available technologies would lead to significant increase in the level of technical efficiency in medium – scale maize production.
Keywords: Technical Efficiency, Constraints, Stochastic Frontier, Maize production, Nigeria

1. Introduction

Maize (Zea Mays, L) is one of the main cereal crop of West Africa, and is the third most Important cereal crop after Sorghum and millet in Nigeria (Ojo 2000) maize is not only a major cereal crop in the present day world but it was also one of the basic food in America before the arrival of Christopher Columbus at the end of 15th century, and among the Indians in Mexico and Guatemela and also among the incus in peru, Bolivia and equator (Rovannent 1987). Maize and other cereal constitute important sources of carbohydrates, proteins, vitamin B and minerals (Iken *et. al.,* 2002). Maize is a stable food crop for most sub-Saharan Africans of which Nigeria is inclusive with per capital kg/year of 40 (FAO SAT 2003). Maize is becoming the miracle seed of Nigeria's agricultural and economic development. It has established itself as a very significant component of the farming systems and determines the cropping pattern of the predominantly peasant farmers, especially in the Northern State (Ahmed, 1996) maize has been of great importance in providing food for man feed for livestock and raw materials for some agro-based industries. Maize constitute a stable food in many regions of the world. It is a basic stable for large population groups particularly in developing countries (FAO and ILO, 1997).

The demand for maize as a result of various domestic uses shows that a domestic demand of 3.5 million metric tones outstrip supply production of 2 million metric tones (Akande, 1994). The ability of the Nigerian agriculture to perform its role in agricultural development according to Ogunsumi *et. al.,* (2005) has been on decline in the last three decades. Hence the Nigerian government adopted different agricultural programmes and policies aimed at raising productivity and efficiency of agricultural sector. These programs and policies placed the small holder farmers in central focus. This was due to the fact that the nations agriculture has always been dominated by the small holder farmers who represent a substantial proportion of the total farming population and produce over 90% of the total agricultural output in the country (Ajibefun *et al*., 2002).

Wikipedia, (2006) reported that maize is hydrolyzed and enzymatically treated to produce syrups, particularly high fructose corn syrup, a sweetener and in some cases fermented and distilled to produce grain alcohol which is traditionally the source of bourbon whisky. Sweet corn is a genetic variation that is high in sugar and low in starch that is served like a vegetable. Another common food made from maize is cornflakes maize is used as meal pap in Africa corn bread is made from maize. Maize is still an important organism for genetic and develops mental biology to date.

Doebly, (1994) reported that maize can be boiled or roasted on the cob, the grains can be cooked fresh or dry and the dry grain can be made into pop corn (guguru) and eaten with roasted groundnuts. Maize is one of the most abundant food crops in Nigeria. About 80% is consumed by man and animals while 20% is utilized in variety of industries processes for production of starch, oil high fructose corn sweetener, ethanol, cereal and alkaline. Maize consist of 71% starch, 90% protein and 4% oil on a dry weight basis.

The Importance of maize cannot be overestimated, economic importance of maize cut across different

spheres of human life, it also serves as food for human consumption, such as pap, popcorn, thick porridge and boiled grains are notable food consumed by majority of Nigerians, mostly in the southern part of the country. Maize is industrially important chiefly for the production of starch and alcohol. The starch can be used as converter dextrin, syrup and sugar; oil obtained from it is used to make soup or refine for cooking and salad dressing.

Land area under maize has increased from 653,000 ha in 1984 to its present level of 5,000,000 m ha., production has also increased from 1,000,000 m tons to 7,000,000 m tons during the same period. Average yield of 1.4 – 1.5t/ha being obtained is low compared to other places (IITA, 2007).

Despite the economic importance of maize, low capitalization price fluctuation, disease and pest, poor storage facilities and inefficiency of resources utilization are the identified problem in maize production in Nigeria (Ojo, 2000). In view of this production efficiency of small holder farms has important implication for the development strategies adopted in many developing countries where the primary sector is still dominant. An improvement in the understanding of the level of production efficiency and its relationship with host of farm level methods can greatly aid policy makers in creating efficiency enhancing policies as well as judging the efficacy of the present and past government reforms in the agricultural sector.

Study Area

The study will be carried out in Afijio Local Government of Oyo State. The choice of the area is due mainly to the huge prevalence of maize farmers in the area.

Afijio Local Government Area was carved out of the defunt of Oyo Local Government area in 1989 having its administration headquarters located at Jobele by the Federal Government of Nigeria. It occupies a land area of 685.085 square kilometers with 2010 estimated population size of 152,193 using growth rate of 3.2% from 2006 census figures. The population density of the area is 222 person per square kilometer. It shares boundary in the north with Oyo East Local Government Area. Akinyele Local Government in the South and Iseyin Local Government Area in the west it also shares common boundary with Ejigbo and Iwo Local Government Areas in East. The Yorubas mainly dominate Afijio Local Government Area. The indigenes are mostly farmers who had taken the advantage of vast agricultural land that favours the cultivation of food crops such as maize, guinea corn, yam, cassava, cowpea, soya beans, fruits, tomatoes and cash crop such as groundnut, cocoa oil, palm, kolanuts, coffee, orange and citrus. The Local Government Area consisting of ten (10) wards in a home for one of the state farm settlement . ilora farm settlement , a number of tourist attraction centers located in the Local Government Areas include ese oloja hill (Ilora), Igi Omo (Ilora), Ifaniyi Hill (Oke Isaini) Ilora, eregun (Ilu Aje) Sogidi Lake (Awe) Odo Eegbe (Fiditi), Obanikoro Ilora, Yemoja (Akinmorin), Kutanti shrine (Awe) among others.

Material and Methods

Table 1: Summary of statistics of key variables of medium-scale maize farmers

Variables	Sample mean	Sample standard mean	Minimum	Maximum
Output(kg)	6915.422	1347.59	3480	99820
Labor (man-days)	8725.12	287.26	596	1897
Land (hectares)	4.85	0.79	5.6	7.4
Fertilizer (kg)	298.66	198.77	0	9720
Family size (number)	5.24	2.46	1	14
Years of schooling	8.64	2.26	0	12
Age of household head (years)	34.66	9.74	18	66
Family experience maize production	10.82	6.21	1	28

Source: Field Survey 2014.

Empirical Analysis

The data used for this study were obtained from survey in the major maize producing area in Afijio Local Government Area of Oyo State, Nigeria. The survey was conducted in March-July, 2014 by the researchers.

The survey collected information on input-output data : data on output of maize production in kg. total labour used in man days total land area planted to maize in hectare, fertilizer used in kg and some socio economic variables like family size, sex of household head, age of household head, years of schooling and farming experience in maize production.

The survey targeted medium scale maize farmers in Afijio Local Government Area of Oyo State, Nigeria. The major maize producing agricultural zones were purposively selected for the study. Afijio Local

Government Area consisting of six(6) major towns then two major towns were randomly selected from the Local Government Area. Two major farming areas were selected from each town and two maize farming villages were randomly selected from each farming areas. Lastly, four medium scale maize farmers were randomly selected from each farming village. The total number of the farmers was 76 for the study.

A summary of the values of the key variables in the stochastic frontier model is presented In table 1. The output of maize produced by sample farmer varied between 3480 and 99820kg with the average of 6915.422kg. The main sources of labour were family, hired and exchange labor, which varied from 596 to 1897 man-days. The average land areas that were cultivated by sample farmers were 4.85ha. The average use of fertilizer in medium-scale maize production was 298.66kg; some of the farmers did not use fertilizer. The average family size of the sample farmers was about 5.

The average years of schooling, age of sample farmers and experience in maize production were 9, 35 and 11 years, respectively indicating that the medium scale maize farmers were quite not too old with considerable experience in maize production but with formal education at least secondary education (completed or uncompleted).

Table 2: Maximum likelihood estimates for parameters of the translog stochastic frontier production function for medium scale maize farmers in Afijio Local Government Area of Oyo state.

Variables	Parameter	Co efficient	Standard error	t-ratio
Production function				
Constant	0	21.430	3.705	5.783**
Labour	β1	-5.488	1.137	-4.827**
Land	β 2	7.521	5.736	1.311***
Fertilizer	β 3	-2.874	1..096	-2.622**
$(Labour)^2$	β 11	0.199	0.386	0.515
$(Land)^2$	β 22	-1.988	1.110	-1.790**
$(fertilizer)^2$	β 33	0.358	0.532	0.672
(labour × land)	β 12	0.211	1.868	0.112
(labour × fertilizer)	β 13	0.396	0.199	1.989**
(land × fertilizer)	β 23	0.0314	0.289	0.108
Inefficiency mode				
Constant	δ_0	0.610	0.0810	7.530**
Family size(z_1)	δ_1	-0.00326	0.0784	-0.0415
Sex(z_2)	δ_2	-o.0742	0.428	-1.733***
Age(z_3)	δ_3	-0.00752	0.00370	-2.032**
Years of schooling(z_4)	δ_4	-0.00178	0.00345	-0.515
Experience(z_5)	δ_5	0.0168	0.00425	3.952**
Variance parameter				
Total parameter	σs^2	0.0369	0.00755	4.887**
Gamma	Γ	0.887	0.112	7.919**
Log likelihood function		33.511		

Source: Computer Analysis, 2014.
Significant at 5% level ** significant at 10%

Stochastic Frontier Analysis

The concept of technical efficiency, in a broad sense, is used to characterized the utilization of resources. These basic concepts may be formulized through a frontier production function define as one that yields maximum output for given levels of inputs. The production frontier is estimated using stochastic frontier approach. The frontier production function is defined as the function that denoted the maximum feasible or potential output that can be produced by a farm from a given combination of input and technology.

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 determinant 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 U. S. Agricultural data, Ogundari and Ojo (2005), Ajibefun *et al*, (2002), Bravy and Pinheiro (1993) and Ali and Byerlee (1991) in which they offer comprehensive review if the application of the stochastic frontier model in measuring the technical and economic efficiencies of

agricultural producers in developing countries. The empirical result from our analysis indicated that the transcendental logarithmic (translog) production function is an adequate representation of data, given the specification as defined below. Because of this funding, result for only the translog stochastic frontier production function are presented in this paper. The translog model that was estimated in this paper is defined as :

$$In\ y_i = \beta_0 \mp \sum_{i=1}^{3} \beta_i In\ x_i + \frac{1}{2} \sum_{i(j)=1}^{3} \beta_{ij} In\ x_i In\ x_j + V_i - U_{ij}$$

Where, Y_i represents the quantity of maize harvested for the sample farmer (in kilogrammes); X_i is the total labour used in medium-scale maize production (in man days); X_2 is the total area of land planted to maize hectares; X_3 is the total quantity of fertilizer used in maize production (in kilogram)

The V_{is} are random errors that are assumed to be independent and identically distributed as $\mu(0,\sigma V_2)$ random variables and the V_{is} are non negative technical inefficiency effect that are assumed to be independently distributed among themselves and between the V_{is} such that U_i is defined by the truncation of the $\mu(\mu_i,\sigma_2)$ distribution, where μ_i is defined by

$$\mu_i = \delta_0 + \sum_{i=1}^{5} \delta j Z j i$$

Where, z_i represent the family size of sample farmer (in number)); z_2 represent the sex of household head (dummied as 1 for male and 0 otherwise); z_3 represent the age of house hold head (in years); z_4 represent the years of schooling of household head and z_5 represent the farmers experience in maize production (in year).

The z_5 are included in the model to indicate their possible influence on the technical efficiencies of the medium scale maize farmers the estimates for all the parameter of the stochastic frontier production function and inefficiency model were contemporaneously obtained using the computer programme Frontier Version 4.1 (COELLI 1996), which estimates the variance parameter in terms of $\sigma s^2 = \sigma^2 + \sigma^2 r$ and $r = \sigma^2 / \sigma s^2$.generalised likelihood ratio statistics, $\lambda = -2In(L(H_0)/L(H_1)$ is the value of the likelihood function for the frontier model in which parameter restrictions that are stated by the appropriate null hypothesis H_0 are imposed and $L(H_1)$ is the value of the likelihood function for the general frontier model. The generalized likelihood ratio statistics has approximately a chi square (or mixed chi-square) distribution if the null hypothesis is true .

Result and Discussion

Estimation of the Frontier Model

The maximum likelihood estimates off the parameters in the stochastic frontier model, defined by equation (1) and (2) are given in table 2. The estimates for the γ - parameter on the stochastic frontier model was quite large (0.887) which means that the inefficiency effect were highly significant in the analysis of maize output of the farmers. Land variables was positive and significant at 10% level. This value implies that Increase in land variables was positive and significant at 10% level and that increase in land by 1% is likely to increase medium scale maize production by 7.521%. Labour and fertilizer input were also significant at 5% but with negative co efficient. These negative values may be as a result of over use of labour and fertilizer by medium scale maize farmers. The co efficient of the square of the logarithm of land was negative and statistically significant at the 5% level. This indicates that the trans slog model exhibited decreased marginal productivity with respect to land. The coefficient of interaction between labor and fertilizer was significant at 5% level. The co efficient of some of the explanatory variables (or determinant) like sex, age and experience were statiscally significant.

The positive signs for experience shows that farmers with higher experience in maize production tended to have higher technical inefficiencies. This could be that they experience the farmers had, was not geared towards the competency or skills needed for excellence in handling the available technologies required in medium scale maize production. This may be in consonance with the dictum, “it is not how far but how well” the estimated negative coefficient for sex of house hold head shows that male headed medium-scale maize household tended to be more technically efficient than female headed household.

So, an additional male headed household will reduce technical in efficiency in medium scale maize production by 0.0742%. the estimated negative co efficient of age of household head means that older farmers tended to have smaller technical inefficiencies than younger farmers, ceteris paribus. This means 1% increase in age of the farmers will reduce technical inefficiencies by 0.00752%.

The null hypothesis, H_0:γ=0 means that there were no technical inefficiencies in medium in scale maize which shows that traditional response function OLS was an inadequate representation of the data for medium scale maize farmers and not trans log model..

The generalized likelihood ratio test was conducted the chi square (x^2) distribution showed that the computed chi square was 36.37 while the critical value of the chi square at 5% level of significance with 7 degree of freedom x^2 (5%.7) was equated to 14.07. Thus the null hypothesis was strongly rejected leading to the

preference of Translog model for adequate representation of the data.

Table 3: Technical Efficiencies of Sample Medium Scale Maize Farmers.

Technical efficiency	Frequency	Percentage
0.401-0.600(medium)	12	15.79
0.601-0.800(high)	40	52.63
0.801-1.000(very high)	24	31.58
Total	76	100.00

Mean 0.749, Min 0.486, Max 0.882.

Technical efficiencies

The mean technical efficiency of all sample farmers selected from Afijio Local Government Area of Oyo state , Nigeria, given the specification of the stochastic frontier model was 0.749, while the maximum and minimum values of the technical efficiency of sampled farmers were 0.882 and 0.486 respectively about 52.63% of the total sampled farmers had high technical efficiencies that were between 0.60 and 0.80 (table 3). Any constraint with % value of 10 and above was a major constraint inadequate processing facilities ranked first among the major constraint are perceived by the sample farmers with the % value of 39.5 followed by lack inadequate access to mechanical services such as tractor hiring with mean value of 25.0.

Table 4: Constraints on maize production as perceived by sample medium scale farmers.

Constraints	Frequency	Percentage %
Inadequate credit	8	10.5
Poor quality planting material	6	7.9
Pests and diseases	5	6.6
Inadequate rainfall	8	10.5
Inadequate transport/mechanical facilities	19	25
Inadequate storage processing Facilities	30	39.5
Total	**76**	**100**

Table 4: Revealed that inadequate storage/processing facilities is the major problem with the frequency 30 and the percentage (39.5%) in the study area. This is followed by inadequate transportation facility with frequency 19 and the percentage (25%) inadequate credit and inadequate rainfall had the same frequency of 8 and percentage (10.5%). Poor quality material had 6 frequency with percentage of (7.9%) while the least is pest and diseases with the frequency 5 and percentage of (6.6%) this revealed that farmers in the study area are faced with constraint that can limit maize production.

Conclusion

The study centered on estimation of technical Efficiency and Constraints of among medium scale maize Production in Oyo State. The study observed that Technical efficiency of medium scale maize farmers varied due to the presence of technical inefficiency effects in maize production in Nigeria. The variable of sex and age decreased the farmers' technical efficiencies, while experience increased their technical efficiencies, while experience increase their technical inefficiencies.

Recommendations

It is therefore recommended that farmers should be encouraged by creating skill acquisition training centre in medium scale maize production so that they can acquire the competencies required in maize production.

Maize production household should be given more incentives for their farming programmes so that increased soyabean production can be witnessed in order to bridge the existing demand and supply gap of maize in Nigeria.

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