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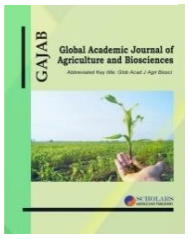

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Research Article

Technical Efficiency of Maize Production in Egbeda Local Government Area, Oyo State, Nigeria

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Abstract: The study analysed the technical efficiency of maize production in Egbeda Local Government Area of Oyo State, Nigeria. Specifically, the study described the socio-economic characteristics of the respondents, determined the technical efficiency of maize production as well as sources of inefficiency among the respondents in the study area. Multistage sampling technique was used to select 120 maize farmers in the study area. Data were collected with the aid of structured questionnaire and analysed using descriptive statistics and stochastic frontier production function. Results revealed that maize production was dominated by male With a mean age pf about 49 years. Majority (83.3%) of the respondents were married with a mean household size of 7 persons. The results of the stochastic frontier analysis revealed that farm size ($p<0.01$), hired labour ($p<0.05$), maize seed ($p<0.01$) and fertilizer ($p<0.05$) were the significant factors influencing maize output in the study area. Inefficiency in maize production was found to increase with household size ($p<0.01$) and income ($p<0.05$) of the farmers while it decreased with sex ($p<0.01$), farming experience ($p<0.01$), cropping pattern ($p<0.01$), membership of cooperative association ($p<0.05$) and extension visits ($p<0.05$). The mean technical efficiency of 74% is an indication that available resources were not utilized optimally by the maize farmers. The study recommended that government at the state and local government area levels should engage the services of the extension officers, mass and social media for timely dissemination of information on modern maize production technologies and improved farm practices to the farmers in order to enhance their efficiency in the study area.

Keywords: Maize production, technical efficiency, stochastic, Oyo State.

INTRODUCTION

Maize (*Zea Mays,* L) is the most important cereal in the world after wheat and rice with regard to cultivation areas and total production [1, 2]. It is one of the main cereal crop of West Africa, and is the fourth most consumed cereal during the past twenty years, after sorghum, millet and rice in Nigeria [3]. Maize is a major and important cereals being cultivated in the rainforest and derived savannah zone of Nigeria. It is also one of the most desirable cereals which serves as the main staple food for millions of Nigerians [4]. It is the most highly consumed grain, accounting for two-third of the calorific intake and grown chiefly by small-scale farmers, at subsistence level as a sole crop or intercropped with other cereals, mostly characterized by small holdings, crude method of

production, low productivity, low resource base and low output [5].

The significance of maize to Nigerian populace cannot be overemphasized. Maize and other cereal constitute important sources of carbohydrates, proteins, vitamin B and minerals [6, 7]. It serves as food for human consumption, 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 pap, porridge or popcorn and eaten with roasted groundnuts. Sweet corn is a genetic variation that is high in sugar and low in starch that is served like a vegetable. Also, cornflakes and corn bread are made from maize [4, 7, 8]. Industrially, maize constitutes the major ingredient of animal feed for poultry, brewery for beer and malt drinks, ethanol for bio-fuel, starch and syrup for medical uses [9], maize starch can be hydrolyzed and enzymatically treated to produce syrups, particularly high fructose corn-syrup, a sweetener, and also fermented and distilled to produce grain alcohol for whiskey production. It is equally used for production of dough ball and fish bait [10]. Oil obtained from it is used to make soup or refine for cooking, salad dressing and glutens. It is useful in alternative medicine, chemicals, biofuel and ornamentals [5]. Also, it is a source of employment for millions of Nigerians from the farmers that cultivate maize to all the value chain actors that engage in its value addition to final consumer [11].

Increase in maize farming in Nigeria has been achieved greatly by expansion in area cultivated rather than increase in yield. The area cultivated increased from 2.8 million ha in 1986 to over 3 million ha in 2000 and over 6 million ha in 2011. The average annual yield calculated for maize in Nigeria ranges from 1.12 to 2.2MT/Ha between 1990 and 2011which was below the expected yield range of 1.5-6.0 MT/Ha based on recommended agronomic practices [12]. In 2019, the annual average yield of 1.8MT/Ha was the lowest among the top 10 maize producers in Africa. It lags behind Egypt and South Africa where the yields were 7.7MT/Ha and 5.3MT/Ha respectively [3]. Nigeria has maintained a very low maize production growth rates when compared to most countries, which translates into insufficient production, for instance, United States produced 345,486 metric tonnes of maize as the leading world producer of maize followed by China and Brazil with 224,580 and 81,500 metric tonnes respectively [13]. Nigeria still spends a lot of its foreign exchange earnings on maize importation. Nigeria import maize product about 215,189 tons of maize for her citizens in 2016/2017 season [14]. Despite the vast number of maize farmers in Nigeria, the crop output is too little; demand outweighs supply due to low yields. Some of the contributing factors to the low productivity includes maize farmers' dependence on traditional method of farming, land tenure, inadequate knowledge on appropriate technologies, technical know-how, inadequate incentives, non-compliance with recommended farm management practices and inefficient use of necessary inputs such as improved seeds and agrochemicals [15; 12] It is against this background that this study analyses the technical efficiency of maize production in the study area. The specific objectives of the study were to: describe the socio-economic characteristics of the respondents, determine the technical efficiency of maize production and analyse the sources of inefficiency among the respondents in the study area.

METHODOLOGY

This study was conducted in Egbeda Local Government Area (LGA) of Oyo State, which is one of the thirty-three LGAs in Oyo State, a suburban located in the rainforest agro-ecological zone. Its headquarters are in the town of Egbeda. It lies between latitudes 7°21'N4°3E' and 8°N of the equator. The LGA is bounded in the North by Lagelu LGA, in the West by Ibadan North East, in the East by Osun State and in the South by Ona-Ara LGA. It has a land area of 420 square kilometres and a population of 398, 500 (2006 census). There are about 195 settlements in the LGA while over 60% of these settlements are rural in nature. The annual mean temperature and rainfall in the area are about 28°C and 2650mm respectively. The people of the LGA are predominantly farmers. Maize production is one of the major sources of income in the LGA.

Data Collection and Sampling Technique

The study was based on the primary data collected with the aid of a well-structured questionnaire administered by the researcher and trained enumerators. Data were collected on socio-economic characteristics of the maize farmers as well as input and output of maize.

Multi-stage sampling technique was used in selecting the respondents for this study. First stage was purposive selection of Egbeda LGA from the 33 LGAs in Oyo State due to the prominence of maize production in the LGA. In the second stage, simple random sampling technique was used to select four wards out of the eleven wards in the LGA. The third stage involved the random selection of two villages in each of the selected wards making a total of 8 villages. At the last stage, 15 farming households was randomly selected from the selected villages making a total of 120 respondents for the study. The sample frame is the list of the maize farmers in the Local Government Area. However, 118 questionnaires

were used for data analysis. The remaining two were discarded due to incomplete information.

Analytical Techniques

Descriptive Statistics

Descriptive statistics such as frequencies, percentages, means, and standard deviation was adopted to describe information on the socio-economic characteristics of the maize farmers.

Stochastic Production Frontier Approach

The Stochastic Production Frontier Analysis was used to determine the technical efficiency and identified the sources of inefficiency in maize production in the study area.

The Cobb-Douglas production function was linearized in this form:

$InYi = \beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + \beta_5 InX_5 + \beta 6 InX6 + V\text{-}U$…… (1) Where: InY_i=Natural Logarithm of Y; Y_i = Maize output (kg); InX_1 = Farm size (ha), InX_2= Family labour (mandays), InX_3 = Hired labour (mandys), InX_4 = Maize seed (kg), InX_5 = Fertilizer (kg), InX_6 = Pesticides (litres). Vi = represent random disturbances cost due to factors outside the scope of the farmers which is assumed to be identically and normally distributed with a mean of zero and constant variance of V~N (o, σ2v) and independent of U.

Ui = non-negative random variable associated with technical efficiency in production, and is assumed to be independently, identically and normally distributed. U~N (o, σ2v) where the conditional mean μ is assumed to be related to farm and farmers-related socio-economic characteristics.

Inefficiency Model

The inefficiency model is specified as

$Ui = \delta_0 + \delta_1 D_1 + \delta_2 D_2 + \delta_3 D_3 + \delta_4 D_4 + \delta_5 D_5 + \delta_6 D_6 + \delta_7 D_7 + \delta_8 D_8 + \delta_9 D_9 + \delta_{10} D_{10}$ …… (2), Where: Ui= inefficiency model, D_1= Age (years), D_2= Sex (1-male, 0-female), D_3= Educational level (years), D_4= Household size (no of people), D_5= Farming experience (years), D_6= Cropping patterns (1 if mixed, 0 otherwise), D_7 = Cooperative membership (dummy), D_8 = Extension contact (dummy), D_9 = Credit access (dummy), D_{10} = Income (Naira), δ= Parameters to be estimated.

RESULTS AND DISCUSSION

Result of the socio-economic characteristics of the maize farmers is presented in Table 1. The result reveals that majority (75.8%) of the maize farmers were male. This implies that maize production is male dominated in the study area. This Is in line with the findings of [11] that maize farming is dominated by male in Oyo State. A larger proportion (30%) of the respondents were within the age range of 46-55 years. The mean age of about 49 years indicates that the ageing population were more involved in maize production than the youths in the study area. This result agrees with the submission of [16] that ageing population of maize farmers could limit adoption of improved technologies and militate against the national objective of attaining self-sufficiency in food production. Distribution by educational status reveals that, a larger percentage (37.5%) of the respondents had secondary education, 28.3% had primary education and 5% had tertiary education while 21.7% had no formal education in the study area. This implies that majority of the maize were literate who could read and write and this could enhance the awareness and adoption of technology for improved productivity in the study area. Majority (83.3%) of the respondents were married. This implies that the maize farmers were responsible farmers who have the obligation of catering for their family members. Also, 60% of the respondents had between 6 and 10 people in their household with a mean household size of 7 persons. This implies that the maize farmers had a large household size which might have implication for family labour availability in the study area. The larger the household size, the more the availability of labour for farming operations.

In terms of farm size, 44.2% of the respondents had more than 2 hectares of maize farmland, 20.8% had between 1.1 and 1.5 hectares of farmland and 18.3% had 1.6-2 hectares of farmland. The mean farm size of 2.8 hectares implies that the maize farmers were small holding farmers. Distribution by maize farming experience reveals that 35.8% of the farmers had 11-20 years of experience, 24.2% had between 20 and 30 years, and 17.5 had more than 30 years' experience in maize farming. The mean years of experience of about 20 years implies that respondents are well experienced and knowledgeable in maize farming. This result is in conformity with the report of [17] that high level of farming experience bears positively on the farmers' efficiency and productivity. Majority (51.7%) of the respondents hired labour to work on their maize farms, 15.8% used family labour while 32.5% used both hired and family labour on their farms. This implies that hired labour was the prominent labour type in the study area. This result confirms the findings of [18] that maize farms are mostly managed by hired labour in Oyo State. Furthermore, 53.3% of the respondents did not belong to cooperative association and 63.3% had no access to credit facilities. This could have negative effects on credit mobilisation and expansion of their farm in the study area. Only

25.4% of the maize farmer had contacts with extension agents in the last production season while majority (74.6%) did

Table-1: Socio-economic Characteristics of the Maize Farmers *n = 118*

Description	Frequency	Percentage	Mean	Std. dev.
Sex				
Female	29	24.2		
Male	91	75.8		
Age				
25-35	16	13.3	48.74	11.492
36-45	33	27.5		
46-55	36	30.0		
Above 55	35	29.2		
Educational Status				
None formally	26	21.7		
Primary	34	28.3		
Secondary	45	37.5		
Adult/vocational	9	7.5		
Tertiary	6	5.0		
Marital Status				
Single	14	11.7		
Married	100	83.3		
Divorced	1	0.8		
Widowed	5	4.2		
Household Size				
Less or Equal to 5	48	40.0	7	1.960
6-10	72	60.0		
Farm Size				
0.5-1	20	16.7	2.8	3.313
1.1-1.5	25	20.8		
1.6-2	22	18.3		
>2	53	44.2		
Experience				
Less or Equal to 10	27	22.5	20.11	11.155
11-20	43	35.8		
21-30	29	24.2		
Above 30	21	17.5		
Type of Labour Used				
Family	19	15.8		
Hired	62	51.7		
Both	39	32.5		
Cooperative Association				
No	64	53.3		
Yes	56	46.7		
Credit Access				
No	76	63.3		
Yes	44	36.7		
Extension Contact				
No	88	74.6		
Yes	30	25.4		

Source: Field Survey, 2019

Not have contacts with extension agents. This implies that the maize farmers may be bereft of research results and information on innovation in the study area. This corroborates the findings of [11] that access to extension service was poor in Oyo State.

Technical Efficiency Estimates of Maize Production in the Study Area

Table 2 shows the result of the Maximum Likelihood Estimate (MLE) of the stochastic frontier analysis of maize farmers in the study area. The study reveals that the gamma estimate which measures the deviation of the observed output from the frontier output is estimated to be 0.725. This implies that 72.5% of the deviations in the total output are largely as a result of the inefficiency in input use and other farm practices, whilst the random factors which may include unfavourable weather conditions, pest and disease infestation, statistical errors in data measurement and the model specification contribute 27.5% to the deviations of the actual output from the frontier output. The estimate of the sigma-square is significantly different from zero at one percent level, attesting to the goodness of fit of the model. The results further reveal that farm size ($p<0.01$), hired labour ($p<0.05$), maize seed ($p<0.01$) and fertilizer ($p<0.05$) were the significant variables influencing maize output in the study area.

The coefficient of farm size was positive and significant at 1% alpha levels. This implies that maize output increase with increase in farm size in the study area. A hectare increase in the size of farmland cultivated to maize will increase maize output by 2.946kg in the study area. This is in line with the findings of [4] and [7] that farm size is a significant factor associated with changes in maize output. Maize seed was also positive and significant at 1% probability levels. This implies that maize output increase with the quantity of maize seed planted in the study area [15] reported similar result. Hired labour and fertilizer were also found to have positive significant relationship with maize output at 5% alpha levels respectively. This implies that an increase in the use of hired labour and fertilizer will lead to increase in maize output in the study area. This result is contrary to the findings of [7] who reported that labour and fertilizer input had negative significant relationship with maize output which may be as a result of over use of labour and fertilizer by medium scale maize farmers in Oyo State.

Sources of Inefficiency in Maize Production in the Study Area

The results of the inefficiency model presented in Table 2 reveal that sex of the farmers reduce inefficiency in maize production as it was negative and significant at 1% alpha levels. This implies that male farmers were more technically efficient that their female counterpart in the study area. This result corroborates the findings of [7] that male headed medium-scale maize household were more technically efficient than female headed household in the study area. Farming experience of the maize farmers ($p<0.01$) was also negative and significant. This implies that inefficiency decreases with farming experience of the respondents in the study area. Farmers with longer years of experience were more technically efficient in the study area. This agrees with the findings of [16] that the negative significant relationship of experience with inefficiency may be due to good managerial skills that the maize farmers have learnt over time. Cropping pattern adopted by the farmers was also found to have a negative significant relationship with technical inefficiency at 1% alpha level. This implies that inefficiency decreases with cropping pattern in the study area. Farmers who adopted mixed cropping were more technically efficient than sole cropping in the study area. The results further indicate that membership of cooperative association ($p<0.05$) plays a significant role in determining the technical efficiency of maize farmers as it was found to decrease technical inefficiency in the study area.

Table-2: Maximum-Likelihood Estimate for Parameters of the Production Function for Maize Farmers in the Study Area

Variable	Parameter	Coefficient	t-ratio
Constant	β_0	0.267**	2.015
Farm size	β_1	2.946***	5.325
Family labour	β_2	-2.041	1.536
Hired labour	β_3	0.564**	2.149
Maize seed	β_4	0.015***	2.749
Fertilizer	β_5	1.056**	2.27
Pesticides	β_6	-1.305	-1.438
Inefficiency Model			
Constant	δ_0	0.113**	2.111
Age	δ_1	-0.195	1.592
Sex	δ_2	-1.105***	-4.251
Education	δ_3	-0.107	-0.351
Household size	δ_4	5.379***	2.76
Farming experience	δ_5	-1.137***	-3.293

Cropping pattern	δ_6	-0.012***	-2.625
Cooperative membership	δ_7	-0.724**	-2.163
Extension visit	δ_8	-0.178**	-2.061
Access to credit	δ_9	0.927	1.419
Income	δ_{10}	0.268**	2.241
Diagnostic Statistics			
Sigma square	σ_2	0.109***	7.33
Gamma	γ	0.725***	5.77
Likelihood function		-115.201	
RTS		**1.502**	

***Significant at 1 percent **Significant at 5 percent*
Source: Computed from Field Survey Data, 2019

Also extension visit was negative and significant at 5% alpha levels implying that inefficiency in maize production decreases with increase in the frequency of extension visit in the study area. This result is in consonance with the findings of [18] that increased extension visits to the maize farmers improve efficiency in Oyo State.

Household size ($p<0.01$) and income ($p<0.05$) were however found to have positive significant relationship with technical inefficiency in the study area. This implies that inefficiency in maize production increase with these variables in the study area. The positive influence of household size could be due to the fact that; the members of the households were not available or involved in maize production activities in the study area. In the same vein, the positive influence of income could be that maize farmers with higher income have diversified into other off-farm activities leading to reduced efficiency in maize production.

The return to scale result in Table 2 demonstrates that maize production in the study area exhibits increasing returns to scale of 1.502 indicating that a percentage increase in all inputs will result in a 1.502% increase in the level of output. This implies that the study area was in stage one of the production process where increase in the level of all inputs used in production results in a more than proportionate increase in output. This is an indication that there is more room for the maize farmers to expand their scale to increase production in the long run, subject to good quality input usage. Similar results were reported by [18, 16].

Technical Efficiency Scores of the Maize Producers in the Study Area

Results in Table 3 reveal that, the technical efficiency of maize producers in the study area ranges from 37% to 96%. Majority (51%) of the maize farmers were concentrated around 51 percent and 70 percent technical efficiency, with 45.8% percent of the farmers achieving 71 percent to 99 percent technical efficiency, while 3.3% achieved 30 percent to 50 percent technical efficiency level. The mean technical efficiency was estimated to be 74.23. This implies that the maize producers in Oyo State were producing at about 74% of the potential production level and that a significant proportion of the maize production was lost due to technical inefficiency factors. This result also indicates that there is room for the maize farmers to improve on their efficiency levels up to 16% in the study area.

Table-3: Technical Efficiency Scores of the Maize Producers in the Study Area

Efficiency Range (%)	Frequency	Percentage (%)
30-40	1	0.8
41-50	3	2.5
51-60	20	16.9
61-70	40	33.9
71-80	19	16.1
81-90	21	17.8
91-100	14	11.9
Minimum efficiency	37.96	
Maximum efficiency	96.12	
Mean efficiency	74.23	

Source: Computed from Frontier 4.1 MLE/Survey data, 2019

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, the following conclusions were made: Maize production was dominated by male in the study area. The farmers were getting old and operated on small scale level. Maize output increased with farm size ($p<0.01$), hired labour ($p<0.05$), maize seed ($p<0.01$) and fertilizer ($p<0.05$). Inefficiency in maize

production increased with household size and income of the farmers while it decreased with sex, farming experience, cropping pattern, membership of cooperative association and extension visits. Maize production in the study area exhibits increasing returns to scale of 1.502. Also, the farmers were not realizing their full productivity potential with a mean technical efficiency of 74% indicating that there is considerable room for improvement in the utilization of inputs used in maize production in the study area. The study therefore recommends that:

1. Youths should be encouraged to take up maize production as a means of livelihood by the state government through provision of modern equipment and improved seeds to make maize farming enterprise more viable.
2. Maize farmers who were non-member of cooperative association should join one for easy access to incentives from government and innovations on maize production that can enhance their efficiency levels.
3. Also, government at the state and local government area levels should engage the services of the extension officers, mass and social media for timely dissemination of information on modern maize production technologies and improved farm practices to the farmers in the study area. Furthermore, the extension officers should be strengthened to organise educational and training workshops on improved agronomic practices so as to boost their technical efficiency in maize production in the study area.

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