Journal of Agriculture, Environmental Resources and Management
ISSN2245-1800(paper) ISSN 2245-2943(online)
6(2)1-800;**February**.2024; pp21- 26

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Resource Use Efficiency of Maize Production in Yewa North Local Government Area, Ogun State, Nigeria

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Abstract: *The study examined the Resource use efficiency of maize production in Yewa North of Ogun State. Multistage random sampling technique was used to select one hundred twenty (120) maize farmers for the study. Data were analysed using descriptive statistics and inferential statistics. Results revealed that maize farmers in the study area is dominated by males (85%) with mean age of 46 years. The inferential statistics employed the use of the stochastic frontier analysis to examine the determinants of output and measure the technical efficiency level of farmers while the marginal value product marginal factor cost approach was used to ascertain whether farmers are efficiently allocating their resources or not. The results from the stochastic frontier analysis indicated that Land, herbicides, labour and quantity of seeds exerted significant and positive effects on maize output whilst the insecticides allocated to maize cultivation had negative and significant effect on maize output. Maize farmers in the study area had a mean technical efficiency score of about 79% indicating an output loss of 21% due to inefficiency. The stochastic production frontier results further revealed that years of education and access to extension agents are factors that significantly affect the inefficiency of maize farmers. In addition, farmers were over-utilizing land while under-utilizing other inputs such as seeds, fertilizers, herbicides, insecticides, labour. The study therefore recommends farm level training programmes for maize farmers through an effective extension services could increase farmer's efficiency level.*

Keywords: Maize, Stochastic frontier analysis; technical efficiency; resource-use-efficiency; Nigeria

Introduction: Agriculture has been undoubtedly known to be a major sector of the Nigeria Economy and even many other countries at large. It has been statistically accounted that it covers up to 35% of the total employment level of the Nigerian economy as at 2020 (Nigerian Economy, 2020). Agriculture remains the foundation and backbone of the Nigerian Economy, providing livelihoods for most Nigerian and generating millions of jobs in spite of its declining contribution to the nation's foreign exchange. Nigeria's wide range of climate, soil variations allows it to produce wide varieties of food and cash crops (United Nations Development Programme (UNDP 2021). The staple food crops can include maize, cassava, rice, wheat, millets and other arable and permanent crops. Maize, cassava, guinea corn, and yam are the major crops cultivated in Nigeria, with 70% of the household engaged in crop farming. Crop production remains the largest driver of the sector and between January and March 2021, Agriculture contributed 22.35% of the total Gross Domestic Product. Maize alone accounts for 5.88 percent of Nigeria's agricultural GDP (Abubakar 2022). Maize is one of the most common and abundant food or cereal crop produced by farmers in Nigeria. About 80% is consumed by man and animals while 20% is utilized in variety of industries for different purposes. It is the cereal crop with the highest yield potential. Maize is more extensively distributed over the earth than any other cereal crop because it adapts to a wide range of climates.

Maize production in Nigeria rose to the highest level since the nation's independence in 1960, a significant improvement for a country that has struggled for decades with below-par domestic production of food. The production of maize increased by 16 percent in 2021 over the previous year. Data also revealed that Nigeria produced 11.6 million metric tons of maize in 2021, the highest quantity made in the last six decades (USDA, 2022) Maize has not only served as a source of food for man and livestock for years, but it has also served as a means and source of income generation and foreign exchange earnings for the country (Alabi and Abdulazeez, 2018). According to Msuya (2008), increasing productivity is crucial for improving the livelihoods of smallholder farmers; He revealed that low productivity in agriculture is one of the primary causes of persistence of poverty among rural farmers and even has

affected the nation in negative ways. Hence, increasing maize productivity is crucial for improving the livelihoods of smallholder farmers in the country. This study therefore seeks to provide solutions to the following research questions; what are the socioeconomic characteristics of maize farmers? Are maize farmers technically efficient? Are maize farmers in the study area efficiently using their inputs. The study is expected to provide valuable benchmark information to these new farmers on resource productivity and profitability in maize production so as to enable them considers its production as a viable option. As for farmers who are already cultivating the crop, the study will go a long way in providing information on ways of boosting production.

Research Methodology: Study Area: The study area was Yewa North Local Government Area of Ogun State formally called Egbado North Local Government Area. Ogun state is located in the South Western part of Nigeria. It is bordered to the West by the Republic of Benin, to the East by Ondo state, to the North by Oyo and Osun states, to the South by Lagos state. Ogun state has twenty (20) local governments. Yewa North Local Government has its headquarters in the town of Aiyetoro which lies on the latitude 70 12'N and longitude 30 3'E in the north-east of the Area. It has a land mass of 2,043.60 square hectares and human population of about 2,338,570 (National Population Commission 2006). It (the local government) shares its boundaries with Imeko-Afon Local Government Area in the North, Yewa South Local Government Area in the south; Republic of Benin in the west and in the East.

Sampling Procedure and Data Collection: The information for the analysis was obtained from a cross-sectional primary data obtained through a structured questionnaire. The selection of the maize farm households was obtained by a multistage random sampling. In the first stage, six (6) farming communities were randomly selected in the Yewa North Local Government Area in proportion to size. The second stage involved a purposive selection of twenty (20) maize farmers in each community to make a total of one hundred and twenty (120) respondents.

Method of Data Analysis: The data were analyzed using descriptive and inferential statistics analytic tools. Descriptive statistics such as percentages, frequency distribution and mean were used to describe the socioeconomic characteristics of maize farmers.

The Stochastic Production function was used for calculating the technical efficiency using the Cobb-Douglas stochastic frontier model. According to Gujarati (2006), the Cobb Douglas Production Model was:

$$LnY=b_0 +b_1 L_n X_1 +b_2 L_n X_2 +b_3 L_n X_3 +b_4 L_n X_4 +b_5 L_n X_5 + b_6 L_n X_6+ U_i \text{ ..... } (1)$$

Where,

Y = yield of maize (kg/ha), X_1 = Seed (kg); X_2 = Labour (Man-days), X_3 = Farm size (ha), X_4 = Fertilizer (kg); X_5 = Herbicides (Litres); X_6 = Insecticides (Litres); L_n= Natural Logarithm; b_0 Constant Term (Intercept); b_1 -b_6 = Coefficient of Parameters Estimated ; U_i = Error Term

To measure the resource-use efficiency of maize production in the study area, the Marginal Value Products (MVP) of the resources used was estimated by multiplying the Marginal Physical Product (MPP) of the inputs with the price of the output. The values was then compared with the cost of the resources Marginal Factor Cost (MFC) in order to make inference on the efficiency of resource-use. The following was estimated to determine the resource-use efficiency of maize production: According to Fasasi *et al.,*(2006) the resource use efficiency was given as:

$$r = \frac{MVP}{MFC} \text{ ..... } (2)$$

Where r= efficiency coefficient; MVP is the marginal value product and MFC is the marginal factor cost of inputs

$$MFC = Px \text{ ..... } (3)$$

Where Px is the unit price of x

$$MVP= MPP.Py \text{ ..... } (4)$$

r = 1, Resources employed by the farmer were efficiently utilized,

r > 1 Resources employed by the farmers were underutilized,

r < 1, Resources employed by the farmers were over utilized.

Results and Discussion: ***Socioeconomic Characteristics of the Sampled Farm Households***

The age of the respondents is an important factor that affect their level of productivity. Age factor is a major socio-economic factor as farmers who are in their most productive ages (30-60) has an edge at higher productivity than older farmers (60 above). Age is believed to influence the level of physical work. Table 1 showed the socio-economic distribution of maize farmers in the study area. The result revealed that an average maize farmer in the study area was 46 years which implies that maize farming in the area was embarked upon by men and women who were physically strong and fit to face challenges in maize farming. This outcome implied that most of them were in their active, productive age; as such, they could easily be engaged in field crop production to cater for their needs and that of their families (Enimu, Igiri and Oduma, 2015). Results on Table 1 further revealed that most of the respondents were males comprising 85%, whereas 15% were females. This result indicated the high participation of males in maize production in the study area compared to their female counterparts. The high involvement of men may be due to the fact that female might be engaged in other occupations aside farming. The finding of the study is in contrary with Ajani and Igbokwe (2011) who stated that women traditionally play significant roles in agricultural activities.

The result of the marital status of the farmers showed that 75% of the farmers were married, indicating that married respondents are involved more in maize production in the study area This could be narrowed to the fact that married people requires income to carter for their families, thereby

suggesting the chances of getting family labour in abundance for use in their production activities (Enimu, Ede and Ofem, 2016)Size of the household can affect level of labour as some farmers might depend on family labour. Farmers with higher sizes thrives better. An increased household size of respondents helps to improve the human resource, that is, labour thereby increasing the efficiency of the farmers. As shown in the result, the mean household size is the study area was 5 persons which implies that the respondents have enough family labour force to work their farming activities. This finding is in conformity with that of Oladiran, Ogunniyi and Fanifosi, (2020), where the mean of household size was 6 persons. Since agricultural production activities are labour intensive, large household size can provide farming labour at little or no cost. Formal education is an avenue to improve the knowledge and rate of skill acquisition. In terms of educational level from Table 1, most of the respondents had one form of education or another with most of them (48.3%) having no formal education, 22.5% had primary education, 20% had secondary education and only 9.2% with tertiary education. This result implied that the respondents in the area were functionally illiterate. The result further revealed that the average farming experience was 14 years which implies that the farmers in the study area are experienced about maize farming. This result was in conformity with (Enimu, Igiri and Oduma, 2015) who outlined that farmers with more years of experience are better compared to farmers with few years of experience.

Estimates of the Determinants of Technical Efficiency Using the Stochastic Frontier Production Function Analysis: Results for the estimation of stochastic frontier production of maize farmers in the study area are presented in Table 2 below. The maximum likelihood estimate (MLE) of the stochastic frontier model of maize farmers is presented in Table 2. The sigma-square (δ^2) estimate of 0.50 attests to the good fit and correctness of the model. The coefficients of variables are very important in discussing the result of the analysis of the data. Among the maize based farmers in the study area the efficiency variables that were significant included Sex, age, marital status, Access to extension agent (significant at 1%) while years of formal education, access to loan were significant at 5% respectively. The estimate parameters of the inefficiency model in the stochastic frontier model of the farmers are also presented in Table 2. The analysis of the inefficiency model shown in the Table (Table 9) showed that signs and significance of the estimated coefficient in the inefficiency model have important policy implication on the technical efficiency (TE) of the maize based farmers. The coefficients of age (-0.009), sex (0.12) marital status (29.87), household size (-0.19), Years of formal education (-0.21) and Access to extension agent (3.30), member of cooperative (-1.04) were significant at 1%, 5%, 10% respectively. This implies that age, household size, years of formal education, member of cooperative led to a decrease in technical inefficiency meaning that, increasing them will lead to increase in technical efficiency of maize based farmers in the study area. This result agrees with the work of Ataboh *et al.,* (2014) in their study on determinants of Technical Efficiency among Rice Farmers in Kogi State, Nigeria.

Level of Technical Efficiencies of Maize farmers: Table 3 shows considerable variation of efficiency index across maize farmers in the study area. The summary of the technical efficiency scores for the respondent in table 3 above reveals that their technical efficiency is equal to or less than 1 indicating that all farmers were producing below the maximum efficiency frontier. A range of technical efficiency is observed across the study area and grouped in the table above. The best farmer had technical efficiency of 1 (or 100%), while the least farmer had a technical efficiency of 0.11 (or 11%). On average, farmers were able to obtain 0.79 (or 79%) potential output from their given combination of production input. The results here imply that given the very wide variation in the level of technical efficiency, there appears to be more than considerable room for effecting greater improvement in the technical efficiencies of the farmers. This result is similar to the work of Ataboh *et al.,* (2014), Oyewole and Ebukiba, (2010), and Usman, (2011).

Resource-use-efficiency Estimation: To measure the resource-use efficiency of maize production in the study area, the Marginal Value Products (MVP) of the resources used was estimated by multiplying the Marginal Physical Product (MPP) of the inputs with the price of the output. The values were then compared with the cost of the resources Marginal Factor Cost (MFC) in order to make inference on the efficiency of resource-use. The results on resource use efficiency for maize farmers in the study area as shown in Table 4 suggest that the farmers were not efficient in the allocation of any of the resources available to them. That is, Seed, Fertilizer, Herbicide, Insecticide and Labour were underutilized, while the land was overutilized by the farmers in the study area. Maize output in Yewa North Local Government could therefore increase if more of such inputs like fertilizer, herbicide, seed, and labour were employed, while quantities of land was reduced. The implication from this study is an indication that the maize farmers in the area of study do not achieve absolute efficiency because they (farmers) under-utilized some inputs, while other inputs were over-utilized. Similar cases of under-utilization and over-utilization of variable inputs were reported by Iheke *et al.,* (2008).

Conclusions: Generally, for optimal use of resources in maize production in Yewa North Local Government, quantities of fertilizer, insecticides, herbicide, labour, seed, should be increased while cost of land should be reduced. Incentives and strategies aimed at encouraging farmers to use more fertilizer, herbicide, insecticides and labour, for resource use efficiency to be achieved by the farmers. Also, from the findings in the study, it can be concluded that age, household size, labour, education level and year of experience in maize farming are the part of the factors that determine the resource use efficiency level of the respondents in the study area. Based on the findings from the results. The following recommendations are suggested:For an effective improve ement in the level of resource efficiency among the maize farmers, provision should be made by governments and other stakeholders in the agricultural sector to provide farmers with access to affordable inputs such as seed, insecticides herbicides as well as making provision for good agricultural practices; Extension agents should be mobilized and sent to the study

area to educate the farmers on the innovations and agricultural practices available for maize farming in order to encourage its production.; Farmers in the study area should employ more of the productive resources such as improved varieties of maize seeds and also increase fertilizer, insecticide, herbicides and labour to boost their productivity; Incentives and strategies could take the form of better management by government of the current fertilizer subsidy programme and efficient input distribution through farmer-based organizations to ensure easy access by farmers especially those in the rural areas.; Maize farmers should be encouraged to join the farmers' association so they can pool their productive resources for large scale farming. Also, farmers should be encouraged by providing credit facilities to them as a motivating factor to encourage their involvement in maize production for earning income to improve their family wellbeing.

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Table 1: Socioeconomic Characteristics of the Respondents

Socioeconomic Characteristics	Frequency	Percentage
Age		
20-30	17	14.2
31-40	27	22.5
41-50	35	29.2
51-60	22	18.3
>61	19	15.8
Mean	**46.38**	
Sex		
Male	102	85.00
Female	18	15.00
Marital Status		
Single	70	14.2
Married	90	75.00
Widowed	10	8.3
Divorced	2	1.7
Separated	8	0.8
Household Size		
1-3	44	36.7
4-6	52	43.3
>6	26	20.00
Mean	**4.56**	
Educational Level		
Non-formal	58	48.3
Primary education	27	22.5
Secondary education	24	20
OND/NCE	5	4.2
B.Sc/HND	6	5.0
Farming Experience		

≤5	30	25
6-10	33	27.5
11-15	19	15.8
16-20	15	12.5
>20	23	19.2
Mean	**13.35**	

Source: Field survey 2023

Table 2: Showing Maximum likelihood estimates of the stochastic frontier production function.

Variables	**Coefficient.**	**Std.Err**	**Z**
Inland	0.355122***	0.084862	4.18
Lnseed	0.087765	0.108095	0.81
Infert	0.025733	0.038233	0.67
Lnherb	0.09472**	0.052595	1.80
Lninsect	-0.08186	0.062944	-1.30
Inlab	0.160404**	0.063748	2.52
Constant	7.672914***	0.400026	19.18
Inefficiency Factors			
Sex	0.122989	1.234176	0.10
Age	-0.00945	0.032553	-0.29
Marital Status	29.87544	1354.181	0.02
Household size	-0.18805	0.183573	-1.02
Years of formal education	-0.20723*	0.13154	-1.58
Access to extension agent	3.308816***	1.236818	2.68
Member of cooperative	-1.03597	1.27124	-0.81
Access to loan	0.088857	1.556865	0.06
Constant	-30.6426	1354.181	-0.02
sigma_v (δ^2)	0.503816***	0.038001	
sigma_u	1.427***		
Gamma (γ)	0.840		
Wald $chi^2(7)$	124.01		
Log likelihood	-95.808687		
Prob>Chi^2	0.000		

Notes: ***p<0.01,**p<0.05, *p<0.1 **Source: Computer Output from Frontier Analysis**

Table 3: Distribution by technical efficiency of the respondents

Technical efficiency scores	**Frequency**	**Percentage**
≤ 0.20	2	1.9
0.21-0.40	4	3.8
0.42-0.60	2	1.9
0.61-0.80	33	31.4
> 0.80	64	61
Mean	0.7906	

Source: Computer Output from Frontier Analysis

Table 4: Input Elasticities and ratio of Marginal Value Product to Marginal Factor Cost

	Elasticity	MPP	MVP	MFC	R	Remark
Land	0.355122	1356.064	55056198	338563983	0.16	Overutilized
Seed	0.087765	19.31971	784380	160643	4.88	Underutilized
Fertilizer	0.025733	10.01154	406468	224779	1.81	Underutilized
Herbicides	0.09472	54.2864	2204027	260194	8.47	Underutilized
Insecticides	-0.08186	16.71599	678669	34568	19.63	Underutilized
Labour	0.160404	36.88082	1497361	30722	48.74	Underutilized