Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.13, No.20, 2022

Effect of Resource Productivity of Maize-Based Farmers on Poverty Reduction in South West, Nigeria

ODUNTAN Oluwakemi[1*]and Jens-Peter LOY [2]
1. Department of Agricultural and Resource Economics, Federal University of Technology, Akure, Ondo State, Nigeria
*Email: ooduntan@futa.edu.ng ORCID: 0000-0003-0978-9290
2. Department of Agricultural Economics, Christian-Albrechts University of Kiel, Germany
Email: jploy@ae.uni-kiel.de ORCID: 0000-0002-4965-1862

Abstract
The ability of Nigerian agriculture to perform its role in the development of the economy has been on the decline in the last three decades. Therefore, the 2030 Agenda's historic commitment to rid the world of the twin scourges of poverty and hunger cannot become a reality if nothing is done about improving resource productivity so as to reduce poverty. This article examined the effect of resource productivity of maize-based farmers on poverty reduction in South-West, Nigeria. Multi-stage sampling procedure was used to select 180 respondents and data were collected with the aid of a structured questionnaire. The stochastic frontier production function, poverty index and probit regression model were used to analyze data from the study. Results showed that age, farming experience, cooperative membership, credit, extension visits, farm distance, and land ownership were significant determinants of efficiency of maize-based farmers. The poverty incidence, poverty gap and poverty severity were 42%, 50% and 11.2% respectively. Results further showed that efficiency and other variables were significant determinants of poverty among respondents in the study area. Policies that facilitate increased production of maize, increased level of education, increased cooperative membership, and access to credit are essential to help reducing poverty among maize-based farmers and among the rural poor in general.
Keywords: Maize-based farmers; Poverty; Probit regression; Resource-productivity, Stochastic frontier analysis.
DOI: 10.7176/JESD/13-20-09
Publication date: October 31st 2022

1. Introduction

The agriculture sector is important for the food and nutrition security. It contributes about 13% to the Gross Domestic Product (GDP) and serves as principal source of livelihood for more than half of the population in Nigeria. Food security and nutrition can be improved greatly as a result of agricultural development. This is possible due to increase in the quantity and diversity of food and because the main driver of economic transformation is agriculture. Agriculture remains the main source of livelihood for most of the people who are under severe poverty (Food and Agriculture Organization, 2016). This is an indication that agriculture plays a very significant role in the growth and development of Nigerian economy. The importance of maize cannot be overemphasized with forty three percent of maize produced in West Africa comes from Nigeria (Kudi *et al.,* 2011). Maize is an important staple food crop in Nigeria, as it provides food for man, feed for livestock and raw materials for some agro-based industries. The third most important cereal in the world is maize, which is next to rice and wheat and has the highest production potential among the cereals (Prathyusha *et al*., 2013).

The present low level of productivity in production of food crop in the country shows that the level of efficiency is low. Achieving sustainable progress in production and availability of food has been hindered with the use of simple technology. However, in the last three decades, Nigeria has been reducing its ability to play its role in agriculture. Umoh *et al*., (2015), estimate that in the rural areas, poverty level is very high, but the level of income of farmers is relatively low. This shows the likelihood of high prevalence of income poverty. Annual production growth slows down. Land and water resources are increasingly stressed, becoming scarce, and reduce in quality due to resource degradation, improved productivity is expected to result to increase in production. The income that comes from most farming households is low to be sufficient to take care of their needs. Thus, the country is plagued with hunger and malnutrition. Rural dwellers are the most Nigeria's population that are badly affected by poverty because agriculture is their means of livelihood which includes maize production (World Bank, 2015). For the country to meet its expected increase of food demand due to the increase in population, increase in per capita food consumption, change in consumption patterns and growing demand for energy; increase in agricultural production needs to be 60% between 2005 and 2050 (Tilman *et al*., 2011). Without addressing the problems of resource productivity in the agriculture sector, many of the Sustainable Development Goals targets especially zero hunger and no poverty cannot be reached. Therefore, the Agenda of 2030 to eliminate poverty and hunger in the world cannot be achieved if nothing is done about resource productivity of major food crops among farmers in Nigeria. Thus, study on the effect of resource productivity of maize-based farmers on poverty reduction remains imperative.

There are many research studies that addressed maize in Nigeria: but the focus is mainly on nutrient uptake, the performance of the maize crop (Ekesiobi *et al*., 2015 and Aderibigbe *et al*., 2017), the resource-use efficiency (Oluwatayo *et al*., 2008, Kasim *et al*., 2014 and Oduntan *et al*., (2016), alleviation of poverty (Oladeebo *et al*., 2017 and Ahmadu and Edeoghon, 2018), and chemical and nutritional analysis (Sule *et al*., 2014). Other research that address poverty include: Anowor *et al*. 2013 conducts a study to evaluate the role of agriculture in poverty alleviation, Aigbokhan (2008) studies growth, inequality and poverty in Nigeria, Iheke and Arikaibe (2012) evaluate the impact of agricultural intensification on poverty alleviation in Nigeria, Ogundipe *et al*., (2016) examine the impact of agricultural productivity on downscaling poverty, , Eseyin *et al*. (2016) investigate the effects of investments in the agricultural sector on poverty reduction in Nigeria. However, an empirical assessment of the effect of resource productivity of maize-based farmers on poverty reduction to our knowledge is missing for Nigeria. For the gap to be filled and to complement previous studies, this study examines the effect of efficiency among other factors on poverty reduction in South-west, Nigeria. This paper therefore describes the socio-economic characteristics of respondents, estimates their income, determines the resource productivity, analyzes the poverty status and determines the effect of resource productivity and other variables on poverty status of maize-based farmers in Nigeria.

2. Methodology

2.1 The Study Area and Data Collection

The study was conducted in South-West, Nigeria. The region is made up of six States which are; Osun, Ogun, Ondo, Lagos, Oyo and Ekiti. The region is bounded in the North and East by Kwara and Kogi States respectively, in the West by the Republic of Benin and in the South by the Atlantic Ocean. The area lies between longitudes 2^o $31'$ and 6^o $00'$ East of Greenwich Meridian and Latitudes 6^o $21'$ and 8^o $37'$ N of Equator (Agboola, 1979) with a total land area of 76,853 km^2 with a population of about 25.2 million (National Population Commission, 2006). The region has an average annual rainfall of 1486mm and an average temperature of 26.7^oC (Omotosho, 2009). The climate of South-West Nigeria is tropical and it is characterized by wet and dry seasons. The wet season is associated with the South-West monsoon wind from the Atlantic Ocean, while in the dry season the North-East wind dominates from the Sahara Desert (Geography of Nigeria, 2017). The three main agro-ecological zones in the area are the swamp on the Atlantic coast, tropical rainforest in the middle and Guinea savannah in the North. Agriculture is the main source of livelihood for the majority of the population. Prominent crops cultivated are maize, oil palm, cocoa, citruses, plantain, banana, cassava, vegetables, rice, kolanut, cashew, sugarcane, cowpea, and pineapple (Oyekale, 2009).

2.2 Sampling Procedure and Data Collection

Primary data were collected for this study. The data were collected from the respondents with the aid of a structured questionnaire. Multi-stage sampling procedure was used in selecting the respondents. The first stage involved a purposive selection of two States noted for growing maize. The second stage involved a random selection of three Local Government Areas (LGA) from each State. The third stage involved a random selection of three communities from each LGA while the last stage involved a selection of ten respondents from a list that was obtained from the Agricultural Development Programme (ADP) office in each of the selected States to make a total of one hundred and eighty respondents that were used for the study.

2.3 Analytical Technique

Descriptive statistics such as frequency distribution, percentage, mean and standard deviation were used to describe the socio-economic characteristics of respondents in the study area.

2.3.1 Budgetary Analysis

Gross margin analysis was used to estimate the costs and returns of maize-based production in the study area. Total Variable Costs include labour, seeds, fertilizer, agrochemicals and transportation. The Total Fixed Cost include depreciation on fixed inputs such as hoes, cutlasses, spades, wheelbarrows and spraying pumps**.** The revenue represents the sales accrued from the sale of maize and those consumed or given out as gift.

The Gross Margin (GM) of an enterprise is the difference between the total revenue and total variable cost. If GM > 0, then the farm enterprise may be profitable, otherwise not profitable.

2.3.2 The Stochastic Frontier Production Function

Stochastic frontier approach was used to determine the resource productivity of respondents in the study area. The Technical Efficiency (TE) of the individual farmer is defined in terms of the ratio of observed output to the corresponding frontier output, conditional on the level of input used by the farmer. The stochastic frontier production function model was estimated using the Maximum Likelihood Estimation (MLE) method. The model is implicitly specified as:

$$TE = \frac{\ln Y_i}{\ln Y^*} = \frac{f(X_i, \beta_i)\exp(V_i - U_i)}{f(X_i, \beta_i)\exp(V_i)} = \exp(-U_i) \qquad (1)$$

Where: TE is the Technical Efficiency, Y_i is the observed output and Y_i* is the frontier output. V_i = random error assumed to be independent of U_i, identical and normally distributed with zero mean and unknown variance. U_i's are non-negative random variables called technical inefficiency effects of production which are assumed to be independent of V_i, β_i's are vectors of unknown parameters to be estimated; and X_i is the vector of input quantities for *i*th farming household.
The TE ranges between 0 and 1 i.e. $0 \leq TE \leq 1$.

2.3.2.1 Model Specification for Technical Efficiency

A Cobb-Douglas was estimated by a logarithmic specification. The variables used were total labour in man days, quantity of seeds used (kilograms), farm size (ha), quantity of fertilizer used (kilograms) and quantity of agrochemicals used (liters).

2.3.2.2 Technical Inefficiency Model

The inefficiency model is defined to estimate the influence of some farmers' socio-economic variables on the technical efficiency of the farmers. The variables used were age (years), age squared (years), level of education (years spent in acquiring formal education), farming experience (years), household size (number of persons feeding from the same household pot and residing together), cooperative membership (1 for membership, 0 for non-membership), access to credit (access =1, no access = 0), access to extension services (access =1, no access = 0), source of seeds (government source =1; 0 = otherwise), farm distance (kilometers), sex (male = 1; 0 for female) and land ownership (individually owned = 1; 0 = group owned).

2.3.3 Measure of Poverty Status

The Foster Greer Thorbecke (FGT) poverty index was used to determine the poverty status of maize-based farmers. In line with past works on poverty (Benjamin *et al*., 2012; Adebo and Ajiboye, 2014), the poverty profiling was based on the per capita household income as a measure of poverty indices and for determining the poverty line.
A relative poverty line was computed based on the Mean Per Capita Household Income (MPCHI) of the maize-based farmers. The Mean Per Capita Household Income (MPCHI) was obtained by dividing the total of all individual household per capita income by the number of households to be surveyed.
Mathematically,

$$\text{Per Capita Income (PCI)} = \frac{\text{Total Household Income}}{\text{Household Size}} \qquad (2)$$

$$\text{Mean Per Capita Household Income (MPCHI)} = \frac{\text{Total Per Capita Household Income}}{\text{Total Number of Households}} \qquad (3)$$

$$\text{Poverty line } (z) = \frac{2}{3}(MPCHI) \qquad (4)$$

Mathematically, this analysis was based on the p–alpha ($P\alpha$) poverty measure proposed by Foster Greer and Thorbecke (1984) which is expressed as:

$$\mathrm{P}_\alpha(y, z) = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^\alpha \qquad (5)$$

z = the poverty line for the maize-based farmers
yi = Per capita income of the *i*th farmer,
q = number of respondents below the poverty line i.e. the number of poor maize-based farmers,
n = Sample size,
α = non-negative poverty aversion parameter and takes on the value 0, 1, 2 which represent the incidence, depth and severity of poverty respectively.

When α = 0, the expression becomes: $\mathrm{P}_0 = \dfrac{q}{n}$ (6)

This is called the poverty rate or incidence of poverty or Headcount index, which measures the proportion of the population that is poor.

When α = 1 in FGT, the expression becomes: $\mathrm{P}_1 = \dfrac{1}{n}\sum_{i=1}^{q}\left(\dfrac{z - y_i}{z}\right)^1$ (7)

This is called poverty depth or poverty gap index, which measures the extent to which individuals fall below the poverty line as a proportion of the poverty line.

When α = 2 in FGT, the expression becomes: $P_2 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^2$ (8)

This is called poverty severity index, which measures the squares of the poverty gaps relative to the poverty line.

2.3.4 Probit Regression Model

A probit model was used to determine the effect of resource productivity and other variables on the poverty status of respondents. A poverty line is constructed to disaggregate the maize-based farmers into poor and non-poor groups. Therefore, households whose Per Capita Total Income (PCTI) is above the poverty line are considered to be non-poor while those with their PCTI below the poverty line were regarded as being poor. Thus, the dependent variable takes the value '1' or 0 for poor and non-poor households respectively. Resource productivity (efficiency scores) and households' socio-economic characteristics were used as explanatory variables.

The probit is given by

$$P\left(Y_t = \frac{1}{x_i}\right) = \frac{\exp(x_i\beta)}{1+\exp(x_i\beta)} \quad (9)$$

This can be expressed as,

$$q_{it} = bx_{it} + e_{it} \quad (10)$$

Where q_{it} = an unobservable latent variable for poor households
X_{it} = vector of explanatory variables
b= vector of parameter to be estimated
e_{it} = error term

The explanatory variables that were included in the model are: age of maize-based farmers (years), level of education (years spent in school), years of farming experience (years), resource productivity (efficiency scores), marital status (married =1, otherwise = 0), household size (number), access to credit/loan (yes =1, no = 0), land ownership (yes =1, no = 0), membership of social group (yes = 1, no = 0) and share of farm income (₦).

3. Results and Discussion

3.1 Socio-economic Characteristics of Respondents

The results showed that about 96.1% of respondents were males (Table 1). This supports the assertion that males are more involved in farming than their female counterparts. This may be due to the fact that most of farming activities involve a drudgery that is easily accommodated by males. This result is similar to the findings by Oduntan *et al*. (2015), Babalola and Olayemi (2013) and Egbetokun *et al.* (2014). The age distribution of farmers showed that most of them (26.6%) were between 50 and 59 years old with a mean age of 48 years which implies that respondents are fairly aged. This result is in line with Babalola and Olayemi (2013) and Abdul-Azeez *et al.* (2014) who find that the average age of the food crop farmers across the study area is 50 and 51 years respectively. This result further underscores the negligence as well as lack of interest of younger adults in farming.

Majority (79.4 %) of respondents were married, which is in conformity with the findings of Javan *et al.* (2015). Results also revealed that most of the farmers (34.4%) had primary school education. The household size of most (47.8%) of respondents range from 1 to 5. The mean household size was 5, which implies a significant number of family members can be employed on the farm to lower the cost of hired labor. Most of the respondents (35.6%) had 21 to 30 years of farming experience with a mean of 27 years. The result further revealed that 63.4% of respondents had less than 5 ha with the mean farm size of 4.7 ha.

Table1:
Distribution of Respondents According to Socio-economic Characteristics

Variables	Frequency	Percentage
Age		
<30	12	6.7
30-39	39	21.6
40-49	38	21.2
50-59	48	26.6
60-69	36	20.0
≥70	70	3.9
Sex		
Male	173	96.1
Female	7	3.9
Level of Education		
No formal school education	48	26.7
Primary school education	62	34.4
Secondary school education	37	20.6
Tertiary school education	30	16.6
Adult education	3	1.7
Household Size		
1-5 members	86	47.8
6-10 members	84	46.6
Above 10 members	10	5.6
Farming Experience		
≤10	19	10.6
11-20	41	22.8
21-30	64	35.6
31-40	19	10.6
41-50	30	16.6
>50	7	3.8
Farm Size		
≤5	114	63.4
6-10	86	36.6

Source: The authors

3.2 Analysis of Costs and Returns of Maize-based Production

Table 2 shows the costs incurred and the revenue realized by the respondents. Results revealed that labor constituted the major cost item for maize-based farmers. The mean value of total revenue, total variable costs and gross margin obtained in the study area were ₦37,755.55, ₦27,331.28 and ₦10,424.27 respectively. The findings revealed that maize-based production was profitable.

Table 2:
Analysis of Costs and Returns

Variables	Mean (₦)	% of TC	Minimum	Maximum
Variable Cost				
Cost of labour	6,380	20.48	2,000	40,000
Cost of seeds	624.44	2.00	200	2,500
Cost of insecticide	2,127.45	6.84	1,000	5,000
Cost of fertilizer	2,065.95	6.63	500	6,000
Cost of transportation	2,975.55	9.55	1,000	15,000
Cost of rent age (land)	13,157.89	42.24	5,000	2,0000
Total Variable Cost (TVC)	27,331.28	87.74	6100	42000
Fixed Cost				
Depreciation fixed assets	3,820.55	12.26	1,800	11,600
Total Fixed Cost	3,820.55	12.26	1,800	11,600
Total Cost of Production	31,151.83	100.0	8000	44200
TR	37,755.55		25,000	75,000
GM	10,424.27		14,300	45,800
GM/TVC	0.38		-	-
TR/TVC	1.38		-	-
GM/TR	0.28		-	-
TR/TCP	1.21		-	-
Net Profit/Total Investment in %	21.19%		-	-

Source: The authors

3.3 Stochastic Frontier Estimates of Production Function Parameters

The estimates of the model were obtained using maximum-likelihood procedures using FRONTIER 4.1 (Coelli and Perelman 1996; Coelli 1996). The results showed that variables such as labor, quantity of seeds, and quantity of agrochemicals were significant determinants of farm output. There was a positive relationship between the level of output of maize and labor, and a negative relationship between the level of output of maize and the quantity of seeds or agro-chemicals. This implies that output increases with labor and decreases with seeds and agrochemicals. The result for labor matches the findings of Oduntan *et al*. (2015). An inefficient or false use of seeds and agrochemicals may explain the negative coefficient. The use of seeds from past production years which might have lost their ability to produce optimally is still prevalent in the study area. Lack of enough information on the application of agrochemicals and its wrong utilization might be a reason for the negative relationship.

The results further revealed that variables such as age, age square, farming experience, cooperative membership, credit, extension visit, farm distance, and land ownership were significant determinants of efficiency of the maize-based farmers. The positive relationship between inefficiency and age square and farm distance implies that an increase in these variables would result to an increase in technical inefficiency of respondents. The results also support the hypothesis that age and age square have positive and negative significant effects on efficiency respectively. This is because as age increases farming experiences increase so that efficiency increases. But at a certain threshold age starts to have a negative effect. This finding is consistent with the work of Chirwa (2007) and Shumet, (2011).

There was a negative relationship between inefficiency and farming experience, cooperative membership, credit, extension visit and land ownership. This implies that, an increase in these variables would result to a decrease in technical inefficiency of respondents. The negative coefficient of farming experience implies that farmers with farming experience are likely to be more efficient in the use of inputs than their counterparts with little or no farming experience. Negative effect of cooperative membership on production inefficiency indicates the role of cooperative membership in improving transmission of technologies and probably in sharing of market information among farmers. This result is also consistent with the findings of George and Ouma (2009).

The results further showed that credit access had a negative and significant effect on farmers' technical inefficiency. This result is consistent with other empirical works like Joachim *et al*. (2004), Gebrehaweria (2008) and Shumet (2011). There is a negative relationship between access to extension agents and technical inefficiency. This implies that technical inefficiency decreases with the number of visits made to the farm household by extension workers. This also indicates that farms that received extension visits are more technically efficient than farms that did not get any advisory service. This result is also consistent with the findings of Beyan and Endrias (2013) and Oduntan *et al*. (2016). Land ownership had a negative relationship with technical inefficiency. This indicates that individually owned farms are more technically efficient than union/co-operative operated farms. The implication could mean that individually operated farms tend to manage their business better, especially when there is implementation of innovative technologies. Sometimes, good innovative ideas are discarded because of disagreement by other members in the union/co-operative owned farms. Ahearn *et al.* (2002) conclude that large corporate farms do not perform better than small individual farms.

Return to scale (RTS) ciphered by the sum of all output elasticities is estimated to be 1.47, implying that on the average, maize-based farms in the study area have increasing return to scale. This means, if the enterprise increases all factor inputs by 1%, maize-based farm output would increase by 1.47%. The result of RTS also implies that most of the farmers were in the stage I of the production process. In order to increase efficiency in this stage, the use of the inputs could be continued until the productivity of such input would reach its optimal level. The estimated return to scale is almost identical to the estimates of 1.42 in Esmaeili (2006), 1.76 in Mesike, *et al*. (2009) and 1.15 in Edward *et al*. (2010).

Table 3:
Maximum Likelihood Estimates of the Stochastic Production Function

Variables	Parameters	Coefficients	Std. Errors	t-ratio
Constant	β_o	5.5978	0.2414	23.1844
Labor	β_1	0.7461***	0.2159	3.4557
Farm Size	β_2	0.8324	6.5558	12.6975
Quantity of Seeds	β_3	-0.0622***	0.0217	-2.8558
Quantity of Agrochemicals	β_4	-0.0729**	0.0281	-2.5934
Quantity of Fertilizer	β_5	0.0273	0.0206	1.3257
Technical Inefficiency Estimates				
Constant	∂_0	-1.4981	0.5670	-2.6418
Age	∂_1	-0.0970***	0.0262	-3.6996
Age Squared	∂_2	0.0007***	0.0002	2.8922
Level of Education	∂_3	0.0317	0.0213	1.4876
Farming Experience	∂_4	-0.0333***	0.0050	-6.6473
Household size	∂_5	-0.0051	0.0118	-0.4357
Cooperative Membership	∂_6	-0.0807*	0.0488	-1.6537
Credit	∂_7	-0.1021*	0.0665	-1.5338
Extension Visit	∂_8	-0.1470**	0.0621	-2.3663
Source of Seeds	∂_9	-0.0457	0.0606	-0.7538
Distance from Home to the Farm	∂_{10}	0.0814***	0.0096	8.4254
Sex	∂_{11}	-0.0905	0.3667	-0.2468
Land Ownership	∂_{12}	-0.1958**	0.1004	-1.9491
Sigma-Squared (σ^2)		0.0472**	0.00523	1.9026
Gamma (γ)		0.98		
Likelihood Ratio Test		138.91		
Log-Likelihood Function		-141.18		
Return to Scale (RTS)		1.47		

Source: The authors, *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

3.4 Technical Efficiency Distribution

The estimated technical efficiencies for maize-based farms in the study area ranged between 0.44 and 0.92 (Fig. 1). About 24.4% of the farms showed a technical efficiency index above 0.90, whereas 52.2% of the farms had efficiency indices between 0.71 and 0.90. Thus about 76.6% of maize-based farms in the study area had a technical efficiency index of 0.71 or above. Only a few farms (23.4%) operated with a technical efficiency index below 0.71. The predicted mean technical efficiency was estimated at 0.80. This indicates that on the average, maize-based farmers produced 80% of the potential (stochastic) frontier output, given the present state of technology and input level. However, 20% of technical potential output was not realized. Therefore, the possibility of increasing maize-based farming production in the study area by an average of 20% can be achieved in the short run by adopting the practices of the best maize-based farm. The estimated mean technical efficiency for maize-based farms in the study area is consistent with the findings of Edward *et al*., (2010), Tan *et al*., (2010) and Beyan and Endrias, (2013).

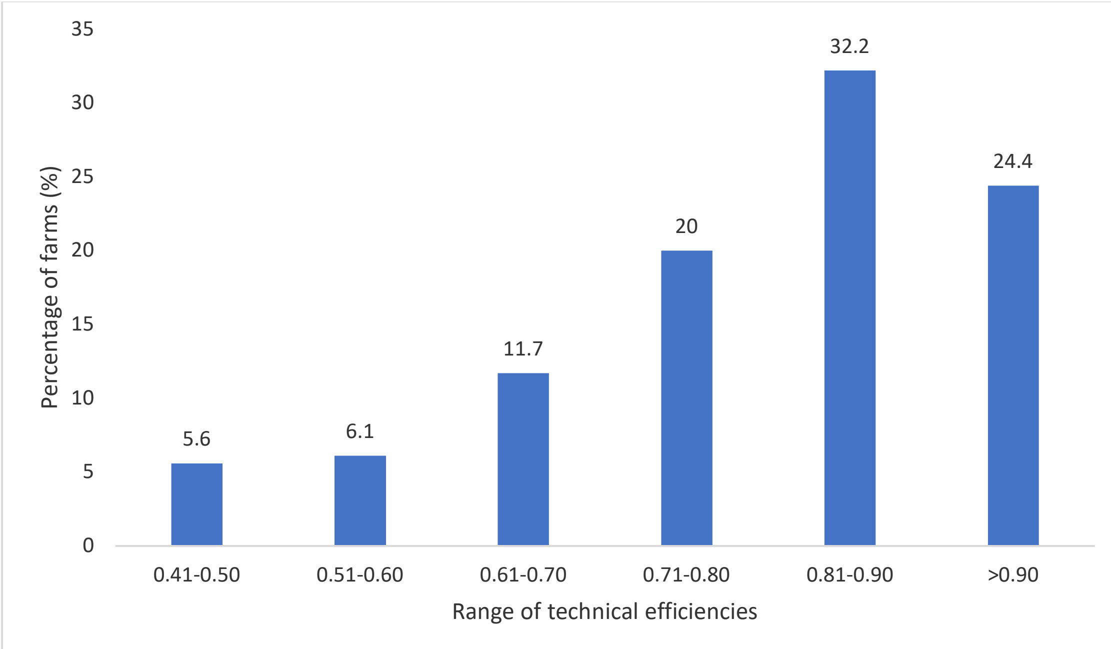

Figure1
Frequency distribution of technical inefficiencies
Source: The authors

3.5 Analysis of Poverty Status among Maize-based Farmers
Foster, Greer and Thorbecke (FGT) poverty index was used to depict the extent of poverty among the maize-based farmers in the study area. The poverty aversion parameters employed were P_0, P_1 and P_2 which means poverty incidence (headcount), gap (depth) and severity respectively. The poverty line computed was ₦ 11,993.52, as the two third (2/3) of the mean per capita income. Thus, the maize-based farmers that earn less than the value of poverty line were considered being poor, while those that earn greater than or equal to the value of poverty line were considered to be non-poor.

As shown in Table 4, the poverty incidence (P_0) in the study area was 0.422 indicating that 42.2% of the maize-based farmers were actually poor based on the poverty line. The poverty gap (P_1) was 0.500. This implies that about 50% of the poverty line is required by the poor households to escape poverty. The poverty severity (P_2) among the maize-based farmers was 0.112, indicating that the poverty severity of poor households was 11.2%

Table 4
Estimate of Poverty Incidence, Depth and Severity

Poverty Index	Incidence (P_0)	Depth (P_1)	Severity (P_2)
	0.422	0.500	0.112

Source: The authors

3.6 Determinants of Poverty among the Respondents
The probit model results presented in Table 5 shows that level of education, efficiency, household size, access to credit, cooperative membership and share of farm income were the significant determinants of poverty among maize-based farmers in the study area. The negative relationship between the level of education of the respondents and the likelihood of being poor indicates that as the level of education of the respondent increases, the probability of being poor is reduced. This is because the level of formal education of a household head would tend to be a positive factor in the adoption of improved farm production and management techniques and enhance the household income-earning capacity. The marginal effect revealed that a unit increase in the years spent in school will lead to 3.7% increase in the probability of not being poor.

The negative relationship between efficiency of the respondents and the likelihood of being poor indicates that as the efficiency of the respondents increases, the probability of being poor decreases. This is attributable to increase in costs per unit of output for a farm, suggesting that as the cost of maximizing output increases, poverty increases, implying that profit is not being maximized. This finding however contrasts with Asogwa, *et al*., (2012). The implication of this is that, farmers that are more efficient in the use of resources tend to minimize costs of production and produce at minimum cost possible compared to farmers that are not efficient. Hence, increase in efficiency decreased the likelihood of being poor. The marginal effect revealed that a unit increase in inefficiency of farmers will lead to 16.8% increase in the probability of being poor.

The results further revealed that the likelihood of being poor was more with large households. This implies that the larger the household size, the higher the probability of being poor. This is because, large household size tends to reduce per capita income available to the household. The marginal effect for household size was 0.0654009 which connotes that as household size increases by one unit, it will lead to 6.5% increase in the likelihood of being poor. The negative relationship between the access to credit and the likelihood of being poor indicated that as the access to credit of the respondent increases, the probability of being poor is reduced. The marginal effect revealed that a unit increase in access to credit will lead to 5.9% increase in the probability of not being poor. The negative relationship between the likelihood of being poor and membership of a cooperative association implies that respondents who were members of cooperative associations would have lower probability of being poor than those who were not members of cooperative associations. This might be as a result of various benefits accruable to members of cooperative societies, such as credit facilities, access to improved production inputs, and access to information and other production incentives that could enhance their productive capacity. These would positively affect farmers' outputs and their income-generating ability, thereby reducing their poverty level. The marginal effect reveals that a unit increase in cooperative membership will lead to 6.1% increase in the probability of not being poor.

The negative relationship between the share of farm income of the respondents and the likelihood of being poor indicates that as the share of farm income of the respondent increases, the probability of being poor is reduced. This implies that farmers that had higher share of farm income would have lower probabilities of being poor than those that had lower share of farm income. This also implies that poverty will be reduced as income increases indicating that as income generation of farmers increases the probability and intensity of poverty decreases. The marginal effect revealed that a unit increase in share of farm income will lead to 4.8% increase in the probability of not being poor.

Table 5
Probit Model Estimation of Poverty Determinants

Variables	Coefficients	Standard Errors	P>/Z/	Marginal Effect
Age	0.0244656	0.0249956	0.328	0.0041446
Level of Education	-0.2029496*	0.1211046	0.084	-0.0372935
Farming Experience	0.0080577	0.0283436	0.776	0.003165
Efficiency	-0.9974964**	0.420237	0.024	0.1689812
Marital Status	0.3262517	0.4598348	0.478	0.0475189
Household Size	0.0386108***	0.0118150	0.015	0.0654009
Access to Credit	-0.0350996**	0.0139261	0.029	-0.0592087
Land Ownership	0.3659347	0.3243005	0.259	0.0714499
Cooperative Membership	-0.3686825*	0.1981542	0.062	-0.0611269
Share of Farm Income	-0.0284001**	0.0122103	0.021	-0.0481044
Constant	2.919199**	1.5471	0.059	

Pseudo $R^2 = 0.8293$
*** Significant at 1% level ** Significant at 5% level, * Significant at 10% level
Source: The authors

4. Conclusion and Recommendations

This article examined the effect of resource productivity of maize-based farmers on poverty reduction in South-West, Nigeria. The study revealed that majority of the maize-based farmers were in their middle age, males, had low education status, operated small maize farm size, had a fairly large household and long years of farming experience. Results also showed that maize-based production was profitable and that variables such as labour, quantity of seeds, and quantity of agrochemicals were determinants of farm output. Age, age square, farming experience, cooperative membership, credit, extension visit, farm distance, and land ownership were determinants of efficiency among maize-based farmers. The study further revealed that almost half of the farmers were poor and the results of the probit regression model showed that efficiency decreased the probability of being poor which suggests that improving efficiency could reduce poverty. Level of education, efficiency, household size, access to credit, cooperative membership and share of farm income were determinants of poverty among maize-based farmers. Nonetheless, these findings have considerable implications for research and policy relating to agricultural development in South-West, Nigeria. First and foremost, they speak to the paramount importance of improving efficiency as a development goal, and for its instrumental value in reducing poverty. Achieving poverty reduction among maize-based farmers in south-west, Nigeria may require policy incentives that improve the efficiency relative to current farmer practices, such as making improved varieties of maize seeds available at subsidized price and also give training to farmers on the use of agrochemicals. Equally important is the reform of public institutions in order to help farmers have access to credit, extension services and technology. Finally, policies that facilitate increased production of maize, increased level of education and increased cooperative membership are essential to help reducing poverty among maize-based farmers and among the rural poor in general.

Acknowledgement: The authors gratefully acknowledge the financial support of The World Academy of Sciences (TWAS) and the Deutsche Forschungsgemeinschaft (DFG) for this research. The authors also acknowledge the support and many inputs received from research group, Department of Agricultural Economics, Christian Albrecht University, Germany. Views expressed and all errors remain our own responsibility.

References

Abdul-Azeez, M. L., Omotesho, K. F., Adekola, O. F., & Adekunle, D. (2014). Assessment of land management practices in food crops production among small scale farmers in Kwara State, Nigeria. *International Journal of Agricultural Management and Development (IJAMAD),* 4(2), 105-116.

Adebo, G. M., & Ajiboye, A. (2014). Comparative analysis of poverty level among rural and urban farmers in Ekiti and Ondo States. *Developing Country Studies*, 11(20), 23-27.

Aderibigbe, S. G., Sakariyawo, O. S., & Kasali, A. O. (2017). Performance of maize (zea mays) cultivars as influenced by grade and application rate of organo-mineral fertilizer in a transitory rain forest. *Agrosearch,* 17 (2), 78 – 98.

Agboola, S. A. (1979). An Agricultural Atlas of Nigeria, *Oxford University Press*, Tropical Africa: Nigeria, 248.

Ahearn, M., Yee, J., & Huffman, W. (2002). The effect of contracting and consolidation on farm productivity. In: *Proceedings of Economics of Contracting in Agriculture Workshop*, Annapolis, Maryland, USA.

Ahmadu, J., & Edeogbon, C. O. (2018). Effect of maize production on poverty alleviation of farmers in Edo State, Nigeria. *Agrosearch*, 18(1), 53-65.

Aigbokhan, B. (2008). Poverty, growth and inequality in Nigeria: A case study. *African Economic Research Consortium* (AERC). Nairobi, Kenya.

Anowor, O.F., Ukweni, N.O. and Ezekwem, S.O. (2013). Agricultural productivity and poverty alleviation: An econometric analysis. *American Journal of Sustainable Cities and Society*, 2(1), 109-129.

Asogwa, B. C., Okwoche, V. A. and Umeh, J. C. (2012). Analysing the determinants of poverty severity among rural farmers in Nigeria: A censored regression model approach. *American International Journal of Contemporary Research*, 2 (5), 166–176.

Babalola, D. A., & Olayemi, J. K. (2013). Determinants of farmers' preference for sustainable land management practices for maize and cassava production in Ogun State, Nigeria. 4th *International Conference of the African Association of Agricultural Economists ICAAAE,* Hammamet, Tunisia 1-18.

Benjamin, C. A., Victoria, A. O., & Joseph, C. U. (2012). Analysing the determinants of poverty severity among rural farmers in Nigeria: A censored regression model approach. *American International Journal of Contemporary Research*, 2(5), 166-176.

Beyan, A., Jema, H., & Endrias, G. (2013). Analysis of farm households' technical efficiency in production of smallholder farmers: The case of Girawa district, Ethiopia. *American-Eurasian Journal of Agricultural and Environmental Science*, 13(12), 1615-1621.

Bozoglu, M., & Ceyhan, V. (2007). Measuring the technical efficiency and exploring the inefficiency determinants of vegetable farms in samsung province, Turkey, *Agricultural System*, 94(3), 649-656.

Chirwa, E. W. (2007). Sources of technical efficiency among smallholder maize farmers in Malawi, *African Economic Research Consortium*, Nairobi, 172, 1-21.

Coelli, T. J. (1996). A guide to frontier version 4.1: A computer program for frontier production function estimation. CEPA working paper 96/07, department of econometrics, University of new England, Armidale. http://www.uq.edu.au/economics/cepa/frontier.php

Coelli, T. J., & Perelman, S. (1996). Efficiency measurement, multi-output technologies and distance functions: with application to European railways. CREPP WP 96/05, Centre de Recherche en Economie Publique et Economie de la Population, Universite´ de Lie`ge.

Duniya, K. and Rekwot, G. (2015). Determinants of poverty among groundnut farming households in Jigawa State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology, 4*(3), 224–230.

Edward, E. O., Berrnhard, B., & Gabriele, H. S. (2010). Elements which delimitate technical efficiency of fish farmers in Ghana. *Journal of the World Aquaculture Society*, 41(4), 506-518.

Egbetokun, O. A., Omonona, B. T., & Adedeji, A. S. (2014). Effects of land degradation on maize-based farm resource productivity in Oyo State, Nigeria. *Direct Research Journal of Agriculture and Food Science (DRJAFS),* 2 (1), 8-12.

Ekesiobi, L. A., Ndukwe, O. O., Ezeano, C. L., Odukwe, K. A., & Nnabuife, E. L. C. (2015). Influence of complementary rate of poultry manure and urea fertilizers on growth and yield of maize (*zea mays* L.) in

South Eastern Agro-ecology zone. *International Journal of Applied Science and Engineering,* 3(1), 8 – 13.
Eseyin, O., Toluyemi, S. T. and Oni, O.O. (2016). Investment in agriculture sector: Implication or poverty reduction in Nigeria. *American Journal of Business and Society*, 1(3), 118-128.
Esmaeili, A**. (**2006). Technical efficiency analysis for the Iranian fishery in the Persian Gulf. *Journal of Marine Science*, 63, 1759–1764.
Food and Agriculture Organization (2016). Sustainable agricultural development for food security and nutrition: What roles for livestock? A report by the high level panel of experts on food security and nutrition. Retrieved from http://www.fao.org/3/a-i5795e.pdf
Foster, J., Greer, J., & Thorbecke, E. (1984). A Class of decomposable poverty measures. *Econometrica,* 52(1), 761 – 766.
Foster, J., Greer, J. & Thorbecke, E. (2010). The Foster–Greer–Thorbecke (FGT) poverty measures: 25 years later. *The Journal of Economic Inequality,* 8, 491–524. https://doi.org/10.1007/s10888-010-9136-1
Gebrehaweria, G., & Namara, R. E. (2008). Investment in irrigation as a poverty reduction strategy: Analysis of small scale irrigation impact on poverty in Tigray, Ethiopia. *International Water Management Institute (IWMI).*
Geography of Nigeria, (2017). Retrieved from: Wikipedia https://en.wikipedia.org/wiki/Geography_of_Nigeria.
George. O., & Ouma, A. S. (2009). What are the key constraints in technical efficiency of smallholder farmers in Africa? Empirical evidence from Kenya*. 111 EAAE-IAAE seminar* small farms: decline or persistence, University of Kent, Canterbury, UK.
Grafton, R. Q., Knowles, S., & Owen, P. D. (2004). Total factor productivity, per capita income and social divergence, *Economic Record*, 80 (250), 302-13.
Gujarati, D. N., & Porter, D. C. (2009). *Basis Econometrics*. New York, NY: Mc Graw-Hill
Idiong, I. C. (2007). Estimation of farm level technical efficiency in small-scale swamp rice production in Cross River State of Nigeria: A stochastic frontier approach. *World Journal of Agricultural Sciences*, 3(5), 653-658.
Iheke, O. R. and Arikaibe, F. A. (2012). Impact of agricultural intensification on poverty alleviation among farm households in Imo State, Nigeria. *International Journal of Development and Sustainability*, 1(3), 1140-1149.
Javan, N., Evans, B., & Anakalo, S. (2015). Influence of gender, age, marital status and farm size on coffee production: A case of Kisii County, Kenya. *Asian Journal of Agricultural Extension, Economics and Sociology,* 5(3), 117-125.
Joachim, N. B., Jean, T., Njankoua, W., Gwendoline, N., and Mireille, A. (2004). Factors affecting the technical efficiency among smallholder farmers in the slash and burn agriculture zone of Cameroon. *Food Policy*, 29, 531-545.
Kasim, I., Mad Nasir, S., Rusli, Y., & Alias, B. R. (2014). Technical efficiency in maize production and its determinants: A survey of farms across agro-ecological zones in northern Nigeria. *Trends in Agricultural Economics*, 7, 57 – 68.
Kudi, T. M., Bolaji, M., Akinola, M. O., & Nasai, D. H. (2011). Analysis of adoption of improved maize varieties among farmers in Kwara State, Nigeria. *International Journal of Peace and Development Studies.* 1(3), 8-12.
Mesike, C. S. Owie, O. E. D., & Okoh, R. N. (2009). Resource-use efficiency and return to scale in smallholders rubber farming system in Edo State, Nigeria, *Journal of Human Ecology*, 28(3), 183-186, DOI: 10.1080/09709274.2009.11906237.
Nchare, A. (2007). Analysis of factors affecting technical efficiency of Arabica coffee producers in Cameroon. AERC Research Paper 163. Nairobi: *African Economic Research Consortium*.
NPC (2006). National Population Commission Nigeria*:* Report on the Survey of Demographic and Health Survey.
Oduntan, O., Amos, T.T., & Oseni, J. O. (2015). Efficiency and profitability of small-scale cassava production in Akure Area of Ondo State, Nigeria*. Journal of Applied Tropical Agriculture.* 20(2), 55-61.
Oduntan, O., Amos, T.T., & Oseni, J. O. (2016). Resource productivity among small- scale maize-cowpea farmers in southwest, Nigeria: A translog functional approach. *Asian Journal of Agricultural Extension, Economics and Sociology,* 13(4), 1-10.
Ogundipe, A., Ogunniyi, A., Oduntan, E. and Olagunju, K. (2016). Agricultural productivity, poverty reduction and inclusive growth in Africa: Linkages and pathways. *Asian Journal of Agricultural Extension, Economics and Sociology*, 1(18), 1–15.
Oladeebo, J. O., Ganiyu, M. O., & Omotayo, A. O. (2017). Analysis of poverty level and land management practices among maize-based food crop farmers in Oyo State, Nigeria. *Proceedings of the 18th Annual Conference of the Nigerian Association of Agricultural Economists* held at the Federal University of Agriculture, Abeokuta, Nigeria 16-19th October, 245-258.
Oluwatayo, I. B., Sekumade, A. B., & Adesoji, S. A. (2008). Resource-use efficiency of maize farmers in rural Nigeria: Evidence from Ekiti State. *World Journal of Agricultural Science*, *4* (1), 91 – 99. Available online at: Idosi.org/wjas/wjas4(1)/17.pdf
Omotosho, J. B. (2009). Pre-rainy Season Moisture Build- Up and Storm Precipitation Delivery in the West Africa

Sahel. *International Journal of Climatology.* DOC: 10.1002/joc.1548.

Oni, O. A. and Yusuf, S. A. (2007). Determinants of expected poverty among rural households in Nigeria. Paper presented at the Centre for the Study of African Economics Research Consortium, 183.

Osuji, E. E., Ehirim, N. C., Eze, E. I., & Osuji, M. N. (2013). Analysis of socio-economic variables on agricultural productivity of some selected arable crops in Imo State, Nigeria. *International Journal of Agriculture and Rural Development,* 16(1), 1385-1391.

Oyekale, A.S. (2009). The effect of climate change on cocoa production and vulnerability assessment in Nigeria. *Medwell Agriculture Journal*. 4(2), 77-85.

Prathyusha, C., Hemalatha, S., & Sharana, B. (2013). Growth and productivity of speciality corn as influenced by different levels of nitrogen under pongamia plantations. *International Journal of Applied Biology and Pharmaceutical Technology*, 4(4), 122-130.

Shumet, A. (2011). Analysis of technical efficiency of crop producing smallholder farmers in Tigray, Ethiopia. MPRA Paper No. 40461, posted 6. August 2012 13:41 UTC Available online at http://mpra.ub.uni-muenchen.de/40461/.

Srinivasan, T.N. (2000). Gowth, poverty reduction and inequality.

Sule, E. I., Umoh, V. J., Whong, C. M. Z., Abdullahi, I. O., & Alabi, O. (2014). Chemical and nutritional value of maize and maize products obtained from selected markets in Kaduna State, Nigeria. *African Journal of Food Science and Technology*, 5(4), 100 - 104.

Tan, S. Heerink, N., Kuyvenhoven, A., & Qu, F. (2010). Impact of land fragmentation on rice producers' technical efficiency in South-East China. *NJAS Wageningen. Journal of Life Sciences*, 57, 117–123.

Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences* USA, 108(50), 20260–20264.

Umoh, N. E., Offiong, R. A., Ekpe, I. A., Yta, E. M., & Enya, E. A. (2015). Assessment of income poverty among farmers in Akwa Ibom State, Nigeria. *Journal of Emerging Trends in Economics and Management Sciences*, 6(8), 345-349.

World Bank (2015). Poverty Overview. The World Bank. Retrieved from http://www. worldbank.org/en/topic/poverty/overview (Accessed on: 01 November, 2020).