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EFFECT OF LAND OWNERSHIP ON THE TECHNICAL EFFICIENCY OF CROP FARMERS

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ABSTRACT. The essence of this study was to examine the land ownership pattern in Osun State, Nigeria, with a view to assessing its effect on the technical efficiency of the farms. Precisely, the farm efficiency level was estimated; factors that determine farm efficiency were identified, and the impact of land ownership on-farm efficiency was also assessed. A three-stage random sampling was used to select 144 respondents. Data collected using a pretested interview schedule was subjected to descriptive statistics, stochastic production frontier function, and average treatment effect. The results show that land ownership by absolute interest accounted for about 65% of the farmers. The mean technical efficiency level of the farms was 47%. Farm size and labour are necessary factors to be increased to have increased output. The non-access to credit and land ownership by absolute interest constituted to technical inefficiency of the farms. Similarly, ownership of farmland by absolute interest reduced efficiency by 24% among sampled farmers and 25.5% among owners of farmland. The study, therefore, suggested that farm size should be increased, and credit facilities are made available to farmers to facilitate the acquisition of necessary inputs to increase output given the existing technology. This can be by way of making accessible to food crop farmers, lands belonging to the government, which are currently not in use.

Keywords: absolute interest; derivative interest; land acquisition; land use system; food crops.

INTRODUCTION

Even though Nigeria is endowed with a vast expanse of productive land, labour, and natural resources, it remains one of the poorest nations of the world, with nearly half of its population experiencing food insecurity (FAO, 2014). The prevalence

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of food insecurity in Nigeria is consequent upon the low productivity of farm businesses experienced by farmers, poor technical efficiency, among others (Oyetunde-Usman and Olagunju, 2019). Although many of the food insecure population in Nigeria are reportedly resident in the agrarian communities, the study by Akinyele (2009) revealed that the spread is across rural and urban communities. Despite being the producers of food, agricultural households are prevalently hit by food insecurity (Kuku-Shittu *et al.,* 2013; Ogunniyi *et al.,* 2016; Ogunniyi *et al.,* 2018). For every human activity on earth, land is considered indispensable because it is the foundation for all material wealth. Land is painstakingly regarded as the most crucial aspect of production, particularly agricultural production. As a factor of the farm output, land is of immense importance in Nigeria because it forms the basis for which crops are grown. Nigeria's agricultural sector is characterised by a large number of small-scale farmers (Mohammed, 2014). Land is, therefore, significantly crucial for small-scale crop farmers, who cultivate small land sizes. These farm sizes are less or equal to 2 hectares (World Bank Rural Development Strategy, 2003), or 5 hectares (Thapa, 2009). They employ majorly family labour, with low capital, and low yield per hectare (Mohammed, 2014), and are also characterized by absolute poverty and severe food insecurity (EU Agricultural Economic Briefs, 2011; Offutt, 2016).

In a bid to regulate the ownership, use, and development of land and land resources, many countries over the years have instituted land ownership systems aimed at the consistent balancing of the interests of the government, the landowning class, and the landless class. Land ownership structure in Nigeria has arguably evolved over the years. In 1978 a single land policy document, known as the Land Use Act of 1978, was established to harmonise and regulate land ownership in the country. Udoekanem *et al.* (2014) contend that the present system of land ownership system in Nigeria, as enshrined in the Land Use Act of 1978, gives the state government excess control over land ownership, use, and development. Land use system is the method by which land is owned and possessed. It is a traditional structure within which decisions are taken about land use (Udoh, 2003). Nigeria's land ownership structure is based on the categories of land rights, which are either absolute interest or derivative interest. The absolute interests are those rights in land that confer upon their holders' unrestricted interests (*i.e.*, total ownership rights). It is regarded as the most superior form of ownership, allowing a total and complete decision on land use and management.

Meanwhile, according to Udoh (2003), the derivative interests have been carved out of the more superior form. They are usually inferior in quality and include leaseholds, life

interests, mortgage, borrowed interests, pledges, among others (Udoekanem *et al.,* 2014). Before rights can be exercised over land, it must be available for acquisition either by inheritance, purchase, lease, pledge exchange, or gift.

According to Onwusiribe and Nwaogu (2017), improving land availability for farmers is crucial to food-crop productivity and food security at the micro and macro levels. As land is a fixed factor of production, it remains the fundamental of human existence and the foundation of food production. Hence, its availability can determine the degree to which food-crops are produced (Iheke and Chikezie, 2016). The degree at which crops are produced considering land (availability, ownership, and use) and other resources in the production process are referred to as efficiency. The general productivity and efficiency level of farm businesses in Nigeria have been researched extensively (Tijani, 2006; Oseni and Winters, 2009; Ogundari, 2014; Oyakhilomen *et al.,* 2015; Ajayi and Adewale, 2018). Studies have also been carried out on land as the bedrock of all agricultural activities, especially regarding farm size, land availability, and tenancy (Iheke and Echebiri, 2010; Mburu *et al.,* 2014; Oladapo and Olajide, 2015; Onwusiribe and Nwaogu, 2017). Many of the studies have tried to establish a relationship between productivity and technical efficiency (Nmadu *et al.,* 2014; Udoekanem *et al.,* 2014; Oluwatayo *et al.,* 2019). As far as we know, this is the first study in Nigeria that is researching the impact that land ownership has on the farms' technical efficiency. Given the preceding, this study sought to estimate the farms' technical efficiency level, identify the determinants of technical efficiency, and assess land ownership's effect on farms' efficiency.

MATERIALS AND METHODS

Study area

This study was carried out in Osun State, Nigeria, which is an inland state in the south-western part of the country lying on latitude 7.5629°N and longitude 4.5200°E. The state has an estimated land size of about 1,487,500 ha (or 14,875 km^2), out of which 1,190,000 ha (80%) are available for agricultural purpose. However, only 761,600 ha are annually put to food crops cultivation, and there are extensive fallow lands owned by the state government. Osun State has an estimated population of 4,137,627 people (NPC, 2006). The economy of the state is predominantly agrarian, with a significant proportion of the population engaged in small-scale farming on lands predominantly owned through inheritance (Osun, 2018). Food crops produced in the state include cassava, yam, cocoyam, cowpea, sweet potato, maize, and some fruits and vegetables.

Sampling technique

This study employed a three-stage sampling procedure. Two agro-ecological zones, Ife/Ijesha and Iwo, were randomly selected from the three agro-ecological zones. Four villages were then randomly selected from each zone in the second stage to give a total of eight villages. In the third stage, the random selection of eighteen farmers from the eight selected

villages was made to give a total of one hundred and forty-four respondents.

Data collection

Semi-structured pretested questionnaire was employed to collect primary data that was used for the study. The instrument was used to capture data on farmers' household characteristics, the status of farmland ownership, as well as inputs and outputs.

Analytical technique

Descriptive statistics were used to describe the socio-economic characteristics of the farmers. The stochastic production frontier was employed to estimate the technical efficiency levels of the farms. The technical efficiency is specified as the ratio of observed output to the corresponding frontier output conditioned on the levels of input used by the individual farms. The model is given as

$$TE_i = \frac{Y_i}{Y^*} = \frac{f(X_i; \beta)\exp(v_i-\mu_i)}{f(X_i; \beta)\exp(V)} = \exp(-\mu_i) \qquad (1),$$

where, TE = Technical efficiency (ranges from 0 to1); Y_i = Observed output from the i^{th} farm; Y^* = Frontier output

The stochastic frontier function was also used to identify the determinants of efficiency for the farms. The maximum likelihood estimate of the stochastic frontier using a Cobb-Douglas production function was used for this study. The Cobb-Douglas function is a non-linear regression model that takes up a logarithm for the dependent and independent variables.

The choice of Cobb-Douglas function is due to its simplicity in terms of analysis and interpretation. The model is specified as:

$$\ln Y_i = \beta_o + \beta_1 \ln X_i + (v_i - \mu_i) \qquad (2)$$

where, i = 1, 2, 3, …, n farms; Y_i = Production of the ith farm; $X_i = k \times l$ vector of input quantities of the i^{th} farm; β_0 = Intercept; β_1 = Vector of the parameters to be estimated; v_i = Stochastic error term which accounts for errors beyond farmer's control and independent of μ_i; μ_i = Negative random error term.

The Cobb-Douglas form of the frontier adopted for this research is written in an explicit form as follows:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + v_i - \mu_i \qquad (3)$$

where, Y = Output (grain equivalent); X_1 = Farm size (hectare); X_2 = Labour (person-day); X_3 = Seed (kg); X_4 = Fertilizer (kg); X_5 = Pesticide (litre); v_i = Stochastic error term; μ = Random error in technical efficiency; $(v_{ij} - \mu_{ij})$ = Composed error term; β_0 = Intercept; β_1, β_2, β_3, β_4, and β_5 are the parameters of the production function to be estimated.

Inefficiency model

The inefficiency model is explicitly written as follows:

$$\mu_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 \qquad (4),$$

where, μ_i = Technical Inefficiency effect; Z_1 = Educational level (years); Z_2 = Farming experience (years); Z_3 = Access to credit (yes = 1, no = 0); Z_4 = Gender (male = 1, female = 0;) Z_5 = Land Ownership (Absolute interest = 1, Derivative interest = 0); δ_0 = Intercept; δ_1, δ_2, δ_3, δ_4, and δ_5 are parameters of the inefficiency model to be estimated.

A negative sign of the coefficients in the inefficiency model implies a

reduction in inefficiency, while a positive sign implies an increase.

The propensity score matching of the treatment effect was employed to estimate the effect of land ownership on the efficiency of the farms. According to Asante *et al.* (2014), the propensity score matching approach has been used in the quest to deal with selection bias associated with the endogenous treatment variable. The propensity score matching approach is based on the assumption of conditional independence, which postulates the existence of a set of observed covariates *k,* which, when controlled for, renders the treatment status independent of the potential outcomes (Khandler *et al.,* 2010). To assess the effect of land ownership on the efficiency of farmers, ownership of land is in two categories. The ownership of land by absolute interest is represented by $y_{i,}$ and the ownership of land by derivative interest is represented $y_{o.}$ The average treatment effect, which represents the expected population impact of land ownership, can be derived as follows:

$$TE_i = y_{i,}1 - y_{i,}0 \quad (5)$$

$$ATE = E(y_i - y_o) \quad (6)$$

where, TE_i = Treatment effect (effect of land ownership by absolute interest on farmer *i*); $y_{i,}1$ = Potential impact for farmers who own land through absolute interest; $y_{i,}0$ = Potential impact for farmers who own land through derivative interest.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the crop farmers

The results in *Table 1* reveal that more than three-quarters of the farmers are male. The predominance of male farmers shows that agricultural activities are male-dominated, which also agrees with Ikala (2010).

The distribution of the farmers by age shows that the modal age group was between 46 and 55 years, with the mean age being 52 years. However, the minimum age recorded for the study was 23 years, while the maximum was 85 years. The results for farming experience shows that almost 90% of the farmers were seasoned crop farmers having more than 10 years of experience. *Table 1* also reveals that the majority (81.94%) of the respondents cultivate less than two hectares of land, with the mean farm size being 1.6 hectares. This indicates that the majority of the respondents are small-scale farmers. However, the minimum farm size recorded for the study was 0.4 ha, while the maximum was 4 ha. Access to extension services can assist in boosting the efficiency and productivity of the farmers. However, almost 85% of the farmers had no extension contact during the production year.

Forms of land ownership

Results from *Table 2* show the distribution of the forms of land ownership. Land ownership by absolute interest (*i.e.,* inheritance, purchase, and gift) constitutes about 65% of the total sampled farmers. Thus, land ownership by derivative interest (*i.e*., rent, lease, and squatting) accounted for the rest. Similarly, ownership by inheritance accounted for most of the forms of

ownership by absolute interest, while rent accounted for the majority of those classified under derivative interest. The relatively high number of farmers who owned land through inheritance may be attributed to the fact that most sampled farmers were natives of Osun state. Meanwhile, juxtaposing ownership by purchase and rent, more farmers took to rent than purchase, and this can be attributed to the high cost of purchasing land in the study area.

Table 1 - Distribution of respondents by socioeconomic characteristics

Characteristics	Category	Frequency (144)	Percentage
Gender	Female	25	17.36
	Male	119	82.64
Age (years)	≤ 35	21	14.58
	36 - 45	8	5.56
	46 – 55	68	47.22
	56 – 65	31	21.53
	> 65	16	11.11
	Mean = 52 years		
	Minimum = 23 years		
	Maximum = 85 years		
Farming experience (years)	≤10	16	11.11
	11 – 20	26	18.06
	21 – 30	49	34.03
	31 – 40	24	16.67
	> 40	29	20.13
	Mean = 27 years		
	Minimum = 1 year		
	Maximum = 60 years		
Farm size (hectare)	≤ 1.00	37	25.69
	1.01 – 2.00	81	56.25
	>2.00	26	18.06
	Mean = 1.6 ha		
	Minimum = 0.4 ha		
	Maximum = 4 ha		
Extension contact	No	122	84.72
	Yes	22	15.28

Source: Field Survey, 2019

Analysis of technical efficiency

The respective scores of the technical efficiency of the food crop farms are presented and discussed below. The technical efficiency indices are shown first. The analysis of the farms' technical efficiency carried out is presented in *Table 3*. According to their technical efficiency level, the distributions of farms show

that the farms have their technical efficiency dispersed around 0.23 and 0.86. *Table 3* further reveals that the mean efficiency of the farms is 0.47. The implication for this is that, on average, sampled farms in the study area have a 47% technical efficiency level. This value indicates a situation of less than maximum efficiency level. Thus if efficiency is increased by 53% on the average, the farms will be operating on the production frontier.

Table 2 - Forms of land ownership

Forms of ownership	Frequency (144)	Percentage
Absolute Interest		
Inheritance	74	51.39
Purchase	9	6.25
Gift	11	7.64
Subtotal	**94**	**65.28**
Derivative Interest		
Rent	32	22.22
Lease	16	11.11
Squatting	2	1.39
Subtotal	**50**	**34.72**

Source: Field Survey, 2019

Table 3 - Distribution of farms by technical efficiency indices

Technical level	Frequency	Percentage
≤ 0.30	8	5.5
0.31 – 0.50	86	59.7
0.51 – 0.70	43	29.9
> 0.70	7	4.9
Total	**144**	**100**
Minimum		0.23
Maximum		0.86
Mean		0.47

Source: Computed from survey data, 2019

Determinants of technical efficiency

The factors that influence the technical efficiency of the farms are presented here. These are shown in *Table 4*.

The result from the maximum likelihood of the frontier is reported as determinants of the inefficiency model in *Table 4*. From the table, farm size and labour are positively significant at 5%. The implication of this is that increasing farm size by one hectare and labour by one person-day would increase farm efficiency by 23.6% and 48.1%, respectively. These finding agrees with those of Baruwa and Oke (2012), Ogundari (2014) and Oyetunde-Usman and Olagunju (2019), who opined that farmers with larger farms are assumed to be proportionately wealthier. Thus they have the financial capacity to purchase, use, and combine inputs in their required proportion, given the existing technology so that they can operate on the production frontier. Similarly, the result is for labour is consistent with those of Ugbagbe *et al.* (2017) and Oyetunde-Usman and Olagunju (2019), who opined that labour is significantly valuable in contributing to farm output, especially among resource-poor farmers. They argue that availability of labour can translate into efficiency. Farming experience, access to credit, and land ownership were also significant at 5%. The coefficient of access to credit was negative, signifying that an increase in credit facility would reduce technical inefficiency.

This result negates Oyetunde-Usman and Olagunju (2019) finding, who found that credit access was positively significant to technical inefficiency.

Table 4 - Maximum likelihood estimates of the stochastic production frontier function

Variables	[a]P	Coefficient	S. E.	t-value
Production model				
Constant	β_0	4.771**	0.73	6.533
Farm size	β_1	0.236**	0.015	15.62
Labour	β_2	0.481**	0.027	17.47
Seed	β_3	0.051	0.052	0.992
Fertilizer	β_4	0.167	0.105	1.594
Agrochemicals	β_5	-0.036	0.075	-0.484
Inefficiency model				
Constant	δ_0	-0.374	0.686	0.545
Education	δ_1	6.33E-03	3.72E-03	1.703
Farming experience	δ_2	0.575E-2**	2.68E-03	2.147
Access to credit (Yes=1; No=0)	δ_3	-0.081**	0.031	-2.645
Gender (male=1; female=0)	δ_4	7.71E-03	0.051	0.151
Extension contact (Yes=1; No=0)	δ_5	-9.79E-03	0.044	-0.224
Land ownership (Absolute=1; Derivative=0)	δ_6	0.271**	0.038	7.079
Variance parameters				
Sigma squared	δ^2	0.028**	3.32E-03	8.679
Gamma	γ	0.999	2.842	0.352
Log-likelihood		50.671		

Note: a = parameters; ** represents 5% significant level;
Source: Computed from survey data, 2019

It was, however, consistent with that of Oyakhilomen *et al.* (2015), who found a negative relationship between access to credit and technical inefficiency among poultry farmers in Nigeria. The negative coefficient of access to credit could be caused by the farmer's comprehensive monitoring of credit facilities for farm activities. Farming experience is positively related to technical inefficiency. This suggests that experienced farmers are significantly less efficient (*i.e.*, increase technical inefficiency). This could be based on the assumption that experienced farmers hold unto traditional knowledge and do not easily adopt new production technologies. Consequently, land ownership had a positive relationship with technical inefficiency. This result implies that farmers who owned land by absolute interest (inheritance, purchase, gift) were less efficient.

Treatment effect on technical efficiency

The result presented in *Table 5* shows the impact of land ownership on the technical efficiency of farms. The analysis employed the nearest

neighbor matching of the treatment effect. In the study, 144 treated data representing the total number of farms owned by absolute and derivative interest was used.

Table 5 - Effect of land ownership on the technical efficiency of farmers

Variable	[a]PSM Method	Treated	Control	Coefficient	[b]S.E.	Z	*p*>|z|
Efficiency	Nearest	144	94	[c]ATE -0.240**	0.005	-39.76	0.000
	Neighbour	94	94	[d]ATET -0.255**	0.007	-34.01	0.000

Note: a = Propensity score matching; b = Standard error; c = Average treatment effect; d = Average treatment effect on the treated; **Source**: Computed from survey data, 2019

Results in *Table 5* reveal that there is a significant effect of land ownership on the technical efficiency level of small-scale crop farms in the study area. The significance level is pictured at 5%. The negative coefficient suggests a reduction in technical efficiency, while the value itself shows the degree of effect on technical efficiency. The result implies that land ownership by absolute interest reduces the technical efficiency of sampled farms by 24%. Thus, a percentage shift to cause an increase in land ownership by absolute interest will give room for a reduction in technical efficiency. On the other hand, technical efficiency is reduced by 25.5% among the absolute owners of farmland. This infers that a percentage shift to allow further cultivation of farms on lands owned by absolute interest will result in a further reduction in technical efficiency by 25.5%.

CONCLUSIONS AND RECOMMENDATIONS

This study has assessed the effect of land ownership on the efficiency of small-scale crop farmers in Osun State, Nigeria. Land ownership by absolute interest and derivative interest were the forms of land ownership. Quantities of farm size and labour are fundamental resources or inputs to be increased to achieve high-level farms' technical efficiency. Similarly, credit facility is a major factor to be increased in a bid to reduce technical inefficiency. The study, therefore, concludes that there is a significant land ownership plays a significant impact in achieving farms' efficiency. The study recommends that the government can assist farmers by making available to the farmers government lands that are lying fallow. This can be by way of renting or leasing the lands to the farmers to be used to boost food crop production. This in turn will boost the income and food security status of the farmers and the nation in the long run. Also, agricultural banks can increase and make available more agricultural loans for farmers to benefit. The availability of credit will go a long way to cater to the availability of agricultural inputs needed for food crop production. By considering this a necessary step to take, it will help in increasing the efficiency level of farms.

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