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Sustaining Smallholder Oil Palm Farmers Productivity Using Land Leasing Market Scheme In Oil Palm Producing Belt of Nigeria

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Abstract

The core intent of the study is to: 1) compare the profitability of the land leasing market scheme participating and non-participating smallholder oil palm farmers in the oil palm producing belt of Nigeria, and 2) assess the effect of the land leasing market scheme on their productivity. A multistage sampling method was employed to select 240 smallholder oil palm farmers (120 land-leasing market scheme participants and 120 land-leasing market scheme non-participants). From the results, the Net Profit Margin Ratio (NPMR) for participating land-lease farmers was 46.41%, and for non-participating farmers was 42.27%. The study further shows that age, farm size, and knowledge of the land leasing market scheme had negative values, and the relationship was significant with land leasing market scheme participation status. The expected oil palm productivity from land leasing participating smallholder oil palm farmers was 2,946.4 kg/hectare compared with 2,042.0 kg/hectare from non-participating farmers. The study recommends that all stakeholders sensitise smallholder oil palm farmers to participate in the land leasing market scheme to increase their productivity.

Keywords: Sustainable development goal, Land leasing market scheme, Productivity, Smallholder oil palm Farmers, Endogenous switching regression model, Oil palm producing belt.

1 | Introduction

Land is part of the soil outward, which houses the biosphere; soil, with its ecological features such as the hydrological cycle and the atmosphere, is vital to human survival and economic existence. The main features of land are fundamental reasons for its critical value for development and economic growth in recent times.

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Therefore, the context of land for farming by tree crop farmers has both commercial and communal connotations that enhance its value [1]. The land is used for farming because it can supply the nutrients needed to enhance crop production; hence, not all lands are suitable for tree crop farming [2]. So, the economic value of land use for tree crop farming must equal the amount that will be received as a return if used for other economic purposes. Hence, a tree crop farmer should be able to earn an income from their agricultural production that is equivalent to the income that will be earned from the same land if put into other commercial purposes. Hence, land use for tree crop farming, such as oil palm, should have a high likelihood of achieving maximum returns. Appropriate land use for oil palm farming should be able to produce a higher quantity of oil palm per hectare than other land. In developing and emerging countries worldwide, smallholder tree crop farms are common; these farms are less than 5 acres in size. However, 80% of global tree crop production comes from smallholder tree crop farmers [3].

In many emerging countries, such as Nigeria, many tree crop farmers, like oil palm, are smallholder farmers who do not have access to extensive farmland. This is affecting their access to credit facilities to boost their tree crop production. National policies impact land-use schemes by affecting institutional activities, such as loan and commercialization facilities, and infrastructure development, as posited by [4]. They put them at a crossroads, and most of the time, they cannot expand their farms. Researchers and policy makers recognized the critical role of secure land tenancy for a sustainable land management system, income-enabling savings, administration of land markets schemes that enhance the allocation of land to the most productive and effective use, and enhancing the availability of credit facilities to the tree crop farmers using land as a guarantee [5]. For example, 80% of land use for tree crop farming in Africa and Asia is cultivated by smallholder tree crop farmers [6]. Due to a lack of land ownership in Africa and Asia, some tree crop farmers participate in land-leasing market schemes. This system enables them to lease farmland. It is a common concept across most African countries that land leasing enables land-deprived people to access land [7].

Palm oil, a significant product of oil palm processing, is a highly commercialized commodity; hence, there is always demand for it in both local and international markets. At the local level, it is consumed as a vegetable oil or used as a material in the production process by small-scale enterprises, such as soap-making. At the industrial level, it is processed for biofuel, animal feed, and chemical products. Due to global demand for palm oil, production has increased in oil palm-producing countries like Nigeria [8]. Many people depend on the oil palm value chain for their livelihoods, and it contributes significantly to the Gross Domestic Product (GDP) of oil palm-producing countries. In view of the above, oil palm farmers' productivity must be sustained; it is necessary to ensure that it remains sustainable as oil palm farming continues to positively impact local livelihoods, Nigeria's GDP, and the economies of other oil palm-producing countries. The existing literature indicates that studies examining the relationship between smallholder oil palm farmers and land rent in Nigeria and other oil palm-producing countries are limited. This highlights a significant research gap and presents opportunities for this empirical investigation.

Understanding the nexus between the land tenure scheme and productivity of smallholder oil palm farmers would assist the policy makers with needed empirical evidence that will enable them to design an impactful program that will lead to more oil palm production among the smallholder oil palm farmers in Nigeria and other oil palm-producing countries like Malaysia, Indonesia, and Colombia. Thus, the study examines the effect of participation in the land leasing market scheme on the profitability and productivity of smallholder oil palm farmers in Nigeria's oil palm-producing belt. A more rigorous approach was used: Net Profit Margin Ratio (NPMR) and the Endogenous Switching Regression (ESR) model were used to analyze the data collected for the study. The study's findings will provide empirical evidence to guide smallholder oil palm farmers in the study area on whether to participate in the land-leasing market scheme and will assist other oil palm-producing countries. It will also guide policymakers on the best land tenure practices to enhance the profitability and productivity of smallholder oil palm farmers. It will ensure continued contributions to oil palm production and to the national economies of Nigeria and other oil palm-producing countries.

2 | Materials and Methods

2.1 | Study Area, Source of Data, Sample Techniques, and Size

The research was conducted in Nigeria's oil palm-producing belt, specifically in Akwa Ibom, Edo, and Ondo States. The three States were purposively selected for the study because they account for almost 39.0% of Nigeria's oil palm production [9]. The three states are made up of 67 Local Government Areas (i.e., Akwa Ibom State has 31, Edo State has 18, and Ondo State has 18). The population of the three states is 13,688,877(i.e., Akwa Ibom is 5,451,000, Edo is 4,777,000, and Ondo is 3,460,877) [10]. Primary data were collected for the study. The primary data were collected using a well-prepared questionnaire loaded onto the Computer-Assisted Personal Interview (CAPI) App. The information collected includes the socio-economic features of the respondents, participation in the land leasing market scheme, costs, and return on oil palm production in the area of study. Land-lease participating smallholder oil palm farmers and non-land-lease participating smallholder oil palm farmers were sampled for the study.

A multistage sampling technique was used to determine which smallholder oil palm farmers to interview. In the first instance, three states (Akwa Ibom, Edo, and Ondo) were deliberately selected for the study because they accounted for 39% of Nigeria's oil palm production in 2024 [11]. Again, two LGAs that are notable for oil palm production were selected for the study. Furthermore, four notable oil palm-producing communities in each LGA were intentionally selected for the study. In each community, five smallholder oil palm farmers who lease land to cultivate oil palm (part or all the land), and five smallholder oil palm farmers who own (all the land) the land they are using to cultivate oil palm, were selected for the study. Therefore, one hundred twenty (120) smallholder oil palm farmers who lease land for oil palm farming, and one hundred twenty (120) smallholder oil palm farmers who were non-land leasing for oil palm farming were respondents for the study.

3 | Methods of Data Analysis

3.1 | Profitability Measurement

Net Income (NI) and NPMR were estimated to assess the profitability of oil palm production among smallholder oil palm farmers participating in the land-leasing market scheme and non-participating smallholder oil palm farmers in the study area.

$$\mathrm{NI} = \mathrm{TR} - \mathrm{TC}. \quad (1)$$

$$\mathrm{NPMR} = (\text{Net Income} \div \text{Revenue}) \times 100. \quad (2)$$

As used by [12] and [13], the NPMR calculation was employed to assess the effect of participation in the land leasing market scheme on the profitability of smallholder oil palm farmers. NPMR was calculated because it assists in presenting the holistic organization's profitability; it is an empirical technique for conducting a comparative analysis of firm profitability by comparing all variables. It enhances a vivid, realistic comparative analysis of the efficiency of invested capital across multiple business entities over a defined period, regardless of their size.

3.2 | Model for Land Leasing Scheme and Productivity

The hypothesis is that smallholder oil palm farmers hedge against risk in all situations; hence, they assess the benefits of participating in the land-leasing market scheme. Participating and non-participating in the land leasing market scheme are represented by $\mathrm{M_{iR}}$ and $\mathrm{M_{iN}}$, respectively. Again, the smallholder oil palm farmers are equally aware of household net benefits and of other preferences. Then, the unobserved net benefits of smallholder oil palm farmer i is stated thus; $\mathrm{M_i^*} = \mathrm{M_{iR}} - \mathrm{M_{iN}}$. Therefore, the net benefit from participation in the land leasing market scheme is a function of the vector of household explanatory variables (Xi) as described in Eq. (3), reflecting the latent framework.

$$M_i^* = X_i' \propto +\varepsilon_i = 1[M_i^* > 0], \quad (3)$$

where M_i represents a dummy variable with 1= land leasing market scheme participating smallholder oil palm farmers (leasing), and 0 = land leasing market scheme non-participating smallholder oil palm farmers (non-leasing), X represents the observable variables that are influencing land leasing market scheme participation status, $\propto$ represents the vector of variables to be evaluated, ε represents the error term which has zero mean and σ_ε^2 represents the variance, which includes the calculated errors and issues that cannot be observed.

Eq. (4) is used to evaluate the effect of the land leasing market scheme on smallholder oil palm farmers' productivity, and it is hypothesized that the outcome variable vector is a linear function of a vector of explanatory variables (K_i) and land leasing market scheme participation status, that is, a dummy variable (M_i) which is expressed thus:

$$P_i = K_i'\beta + M_i\gamma + \mu_i, \quad (4)$$

where variable P_i is a vector of outcome variables, K_i is a vector of farm and household features, M_i represents the land leasing market scheme participation status, and the random error term represents μ_iThe parameter vector to be evaluated is β and γ.

In line with [14], [15], an ESR model was applied to simultaneously assess the determinants and the effect of land-leasing market scheme participation status on smallholder oil palm farmers' productivity. The model captures the observable and unobservable variables that account for the effect. Due to the continuous nature of the outcome variables and productivity, the model is appropriate for the study.

In modelling the effect of participation in the land leasing market scheme on smallholder oil palm farmers' productivity, a two-stage evaluation technique was applied simultaneously using the ESR framework. The factors influencing the land leasing market scheme participation status, as shown in *Eq. (3),* were first evaluated. Then, the two regimes of land leasing market scheme participation and non-participation were evaluated. The specifications for the two regimes are given as follows.

Regime 1 (land leasing participants)

$$P_{iR} = K_{iR}'\beta + \mu_{iR} \text{ if } M_i = 1. \quad (5a)$$

Regime 2 (land leasing non-participants)

$$P_{iN} = K_{iN}'\beta + \mu_{iN} \text{ if } M_i = 0, \quad (5b)$$

where P_{iR} and P_{iN} are outcome variables for land leasing market scheme participants and land leasing market scheme non-participants, respectively; K_i represents the vector of farm and household features; μ_i represents the random error term, and β represents the vector of parameters to be evaluated. According to [16], λ_R and λ_N is used to capture the selectivity terms used in the selection equation for land leasing market scheme participants, and non-participants, respectively, as well as covariance terms σ_{RN} and $\sigma_{R\varepsilon}$ in *Eqs. (5a)* and *(5b)* that led to *Eqs. (6a)* and *(56)*;

$$P_{iR} = K_{iR}'\beta + \sigma_{RN}\lambda_R + \emptyset_{iR} \text{ if } M_i = 1. \quad (6a)$$

$$P_{iN} = K_{iN}'\beta + \sigma_{R\varepsilon}\lambda_N + \emptyset_{iN} \text{ if } M_i = 0. \quad (6b)$$

The technique used in this study is the maximum likelihood method as used by [16].

To evaluate the effect of leasing market scheme participation on smallholder oil palm farmers' productivity, the ESR model is employed by comparing the expected productivity of participating smallholder oil palm farmers with the expected outcomes of counterfactual hypothetical cases that did not participate. The expected values of the outcome P on land leasing market scheme participants and non-participants are expressed as follows:

$$E(P_{iR}|M = 1) = K'\beta_{iR} - \sigma_{R\varepsilon}\lambda_R. \quad \textbf{(7a)}$$

$$E(P_{iN}|M = 1) = K'\beta_{iN} - \sigma_{R\varepsilon}\lambda_R. \quad \textbf{(7b)}$$

Using *Eqs. (8a)* and *(8b)*, the Average Treatment Effect (ATE) on the treated, which is the change in the outcome due to participating, and is the difference in the expected outcomes from *Eqs. (7a)* and *(7b)*.

$$ATT = E(P_{iR}|M = 1) - E(P_{iN}|M = 1). \quad \textbf{(8a)}$$

$$ATT = K(\beta_{iR} - \beta_{iN}) + \lambda_R(\sigma_{R\varepsilon} - \sigma_{R\varepsilon}), \quad \textbf{(8b)}$$

Where σ represents the covariance of the error terms, and λ the inverse form ratios or selectivity term.

The independent variables that were used in the model are;

K_1 = Gender (1 if male, 0 otherwise)

K_2 = age (in years)

K3 = Age^2 (in years)

K_4= Marital status (1 if married, 0 otherwise)

K_5 = Years of education (in years)

K_6=Household's size (in numbers)

K_7= Farming experience (in years)

K_8= Access to credit (1 if have access, 0 if otherwise)

K_9= Association/Cooperative membership (1 if a member, 0 if otherwise)

K10 = Family labour

K_{11} =Hired labour (person-days)

K_{12}= Quantity of fertilizer (Kilograms)

K_{13}= Quantity of herbicide (Liters)

K_{14} = Farm size (hectare)

K_{15} = Knowledge of the importance of land leasing (1 if aware and 0 if not)

4 | Results and Discussion

4.1 | Smallholder Oil Palm Farmers Leasing Market Types

Fig. 1 presents the market types for the smallholder oil palm farmers' leasing scheme. The result revealed that 70% of the land-leasing farmers subscribed to the cash leasing system and will pay cash from the proceeds of selling processed oil palm (palm oil). At the same time, 30% were involved in the crop-share system, which involves the sharing of First Fruit Bunches (FFB) in an agreed ratio. This result buttresses the assertion that most tree crop farmers in Kenya's land-leasing market prefer cash leasing to crop sharing, likely because they keep the extra profits from large crops [17].

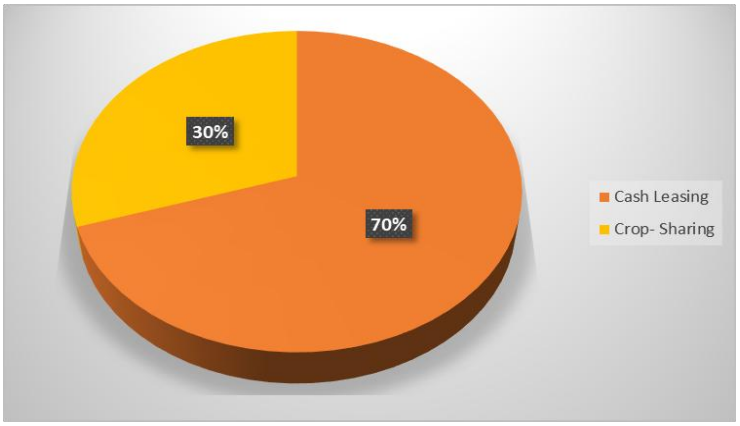

Fig. 1. Smallholder oil palm farmers leasing market types.

4.2 | Estimation of the Effect of Land Leasing Market Scheme on the Profitability of Smallholder Oil Palm Farmers

Table 1 presents the average costs and returns in naira and dollars for participating smallholder oil palm farmers in the land-leasing market scheme and non-participating smallholder oil palm farmers. The total revenue for both land leasing market scheme participants and non-participating farmers was N2,805,243.30 ($1,828.71) and N2,110,186.34 ($1,375.61), respectively. The total variable costs for the land leasing market scheme-participating farmers and non-land leasing farmers were N1,386,182.34 ($903.64) and N1,094,534.68 ($713.52), respectively. It corroborates [18] 's findings in China that participants in the land-leasing market scheme enhance farmers' profitability and productivity. The most significant cost for both land-leasing and non-leasing farmers was labour (22.16% and 26.48%, respectively). It is consistent with the findings of [8], which indicate that labour is one of the important costs for smallholder oil palm farmers in the rainforest agroecological zone. Again, the cost of leasing land accounted for 16.65% of the total land-leasing costs for farmers, which was a significant share. It attests to the findings of [19] that, in China, among smallholder farmers, the cost of leasing land for farming is one of the most significant costs. Hence, the need for policymakers at all levels of government to come to the rescue of smallholder farmers, such as oil palm farmers, by ensuring a land tenure system that reduces the amount farmers pay to lease land. It buttresses the findings of [20] that land leasing costs are an essential burden for smallholder farmers in emerging countries. The total fixed cost for the leasing farmers was N117,080.29 ($76.32), and for the non-leasing farmers, N106,770.62 ($69.60). The value indicates that both participating and non-participating farmers were smallholder oil palm farmers who did not use heavy equipment. Therefore, they are small-scale tree crop farmers and cultivate small hectares of land.

The gross margin for the land leasing market scheme participating farmers was N1,419,060.96 ($925.07), and for non-participating farmers was N1,015,651.66 ($662.09). The NI of participating and non-participating farmers was estimated at N1,301,980.67 ($848.75) and N908,881.04 ($592.49), respectively. The results show that oil palm production is profitable for both land-leasing participants and non-participants. It buttresses the findings of [13] that oil palm production in Nigeria is a profitable venture.

However, using the gross margin, and the NI to decide the most profitable between land leasing market scheme participants and non-participants farmers will be misleading, since the land leasing participating farmers could likely be cultivating more hectares of land than the non-leasing farmers as shown in the total variable cost, total fixed cost, total cost, total revenue, gross margin, and NI. Therefore, using the NI value to assess a business organization's productivity and return on investment, unless it is related to other figures such as revenue, will be misleading. To quantify working capital efficiency and determine operational effectiveness, profitability evaluation is one of the most appropriate methods [12]. So, NPMR, which provides

a holistic picture of firm profitability, reflects returns on investment for any firm and enhances comparisons between two or more firms over a given period of time, was estimated.

The NPMR for participating farmers in the land-leasing market scheme was 46.41%, and for non-participating farmers, 41.27%. Thus, the participating farmers' profitability was higher (5.14%) than that of non-participating farmers. Therefore, the land leasing market scheme increased participating farmers' returns on investment relative to non-participating farmers during the three years evaluated. Likewise, the greater the NPMR, the higher the firm's operational effectiveness. A firm with a higher NPMR shows that it increased revenue and reduced operating expenses. It may be because smallholder oil palm farmers who participated in the land-leasing market scheme were aware they were leasing land and would pay rent. So, there is a tendency for them to be more proactive and to be conscious of their spending. The result supports the assertion of [21] that small farm size and low efficiency can be mitigated by allowing farmers to transfer farmland to others for production.

Table 1. Three-year average cost and return analysis of smallholder oil palm production in the study area.

	Land Leasing Participating Farmers			Land Leasing Non-Participating Farmers		
Items	**Mean (N)**	**$**	**% TC**	**Mean (N)**	**$**	**% TC**
A. Revenue FFB Sold	2,805,243.30	1,828.71		2,110,186.34	1,375.61	
Variable Items						
Cost of family labour	146,873.84	95.75	9.77	132,145.46	86.14	11.00
Cost of hired labour	333,111.76	217.15	22.16	318,052.62	207.34	26.48
Cost of seedlings	153,984.43	100.38	10.24	157,297.93	102.54	13.09
Cost of fertilizer	110,829.25	72.25	7.37	114,651.48	74.74	9.54
Cost of pesticide	104,011.01	67.80	6.92	115,941.67	75.58	9.65
Cost of Herbicide	113,098	73.72	7.52	104,729.53	68.27	8.72
Cost of transportation	118,329.05	77.14	7.87	105,365.99	68.69	8.77
Tax and levy	55,670.00	36.29	3.70	46,350.00	30.22	3.86
Cost of land leasing	250,275.00	228.34	16.65	-	-	-
TVC	1,386,182.34	903.64	92.21%	1,094,534.68	713.52	91.11%
Fixed items						
Dep. cost of cutlass	56,639.87	36.92	3.77	54,874.16	35.77	4.57
Dep. cost of wheelbarrow	60,440.42	39.40	4.02	51,896.46	33.83	4.32
TFC	117,080.29	76.32	7.79%	106,770.62	69.60	8.89%
TC (B + C)	1,503,262.63	979.96	100	1,201,305.30	783.12	100
Gross margin (TR –TVC)	1,419,060.96	925.07		1,015,651.66	662.09	
NI (TR – TC)						
NPMR (NI/TR) x 100 =	1,301,980.67	848.75		908,881.04	592.49	
	46.41%			41.27%		

Note: $1 = N1534.

4.3 | Determinants of Smallholder Oil Palm Farmers' Participation in Land Leasing Market Scheme

The findings on the variables that induce smallholder oil palm farmers to participate in the land leasing market scheme are shown in *Table 2* (Selection column). The findings can be interpreted as normal probit coefficients. From the column, age, fertilizer application, farm size, and knowledge of the land leasing market scheme had negative values but were significantly associated with participation in the land leasing market scheme. The inference from this situation is that these variables reduce the likelihood of smallholder oil palm farmers' participation in the land-leasing market scheme. The age reports that older (i.e., above 60 years) smallholder oil palm farmers will not be willing to lease land for oil palm cultivation. The strength and vigour will not be there again to cultivate a large farm; this also buttresses [21] 's findings among Coffee farmers in Kenya. The household size, with a negative coefficient and a significant influence on land leasing participation status, may be due to the small household sizes in the study area. The mean household size was 4 among participating farmers in the land-leasing market scheme and 5 among non-participating farmers. There is a negative

relationship between fertilizer application and land-leasing participation status among smallholder oil palm farmers, meaning that the more fertilizer is applied, the lower the probability of participation in the land-leasing market scheme. Most smallholder oil palm farmers believed that applying fertilizer would increase their productivity, a finding in line with [22] among cocoa farmers in Ghana. The negative association between farm size and the land leasing participation status indicates that larger farm size among smallholder oil palm farmers reduces the likelihood of participating in the land leasing market scheme. In tree crop production, most farmers with large farms will not be willing to participate in the land lease market scheme, since they already have large farms to cultivate. This is in line with the findings of [23] in United States of America (USA) because the tree crop farmers participating in the land leasing market scheme will pay tax on the income from the leased farmland.

Knowledge of the land leasing market scheme has a negative, significant relationship with land leasing participation status. It is probably because most landowners live on income from leasing land and are mostly inconsiderate. Hence, they benefit more than the smallholder oil palm farmers from the improvement of their productivity in oil palm production, because they demand more rent from the smallholder oil palm farmers as their productivity increases. It will definitely not encourage some farmers who are aware of the landlord's nature, as is the case in the Philippines [24].

The positively significant association between household size and farm experience with land leasing participation status indicates that household size among respondents was small; therefore, the smaller the household size, the greater the likelihood of smallholder oil palm farmers' willingness to participate in the land leasing market scheme. The reason could be that farmers with smaller household sizes will have sufficient funds to participate in the land-leasing market scheme, since household consumption expenditure would be minimal. It supports [25] 's findings from their study in Malawi and Zambia on the rural land leasing market scheme in Africa: the smaller the household size, the greater the likelihood that a farmer will participate in the scheme. Also, the higher the farm experience, the higher the likelihood that smallholder oil palm farmers will participate in the land-leasing market scheme. It may be due to the years of experience of smallholder oil palm farmers, which helps them choose more land for cultivation and participate in the land-leasing market scheme, similar to what happened in Vietnam [26].

Table 2. The result of maximum likelihood estimates of the ESR model for land leasing participation and the effect of land leasing participation on smallholder oil palm farmers' productivity.

	Selection		Land Leasing Partaking Farmers		Land Leasing Non-Partaking Farmers	
	Coefficient	T-Value	Coefficient	T-Value	Coefficient	T-Value
Constant	0.753	0.799	7.393	2.347	0.121	0.019
Gender	0.275	0.883	0.537*	0.221	0.218	1.617
Age	1.012	0.339	0.025	8.083	0.398***	0.014
Age^2	-0.733***	0.071	0.011	0.835	1.105	2.031
Marital status	-0.445	1.065	0.674*	0.109	1.801	1.912
Years of education	-0.038	1.488	-0.019	0.593	0.813***	0.069
Household size	1.083*	0.069	-0.129***	0.006	1.142	1.079
Farming experience	1.087***	0.035	0.045	2.408	-2.290	2.901
Access to a credit loan	-0.184	0.859	0.476**	0.134	1.121	1.872
Association/cooperative membership	-0.012	0.036	0.480*	0.133	-1.076	1.872
Family labour	0.198	1.791	0.609***	0.217	2.137	3.009
Hired labour	-4.01e	1.001	1.913	2.239	1.426	1.230
Seedlings	1.029	0.593	-0.013	0.823	-1.751	1.063
Fertilizer application	-0.646**	0.156	-0.168**	0.071	0.887	0.971
Herbicide	1.01	0.048	0.081	7.647	0.072***	0.005
Farm size	-0.652***	0.094	1.114	8.228	-0.212***	0.045
Knowledge of the land leasing market scheme	-1.587*	0.188				

Table 2. Continued.

	Selection		Land Leasing Partaking Farmers		Land Leasing Non-Partaking Farmers	
	Coefficient	**T-Value**	**Coefficient**	**T-Value**	**Coefficient**	**T-Value**
$\ln\sigma_1$			-4.197*	1.984		
ϱ_1			-6.719***	1.852		
$\ln\sigma_2$					-0.212***	0.033
ϱ_2					+3.407***	1.026
Log likelihood	-193.50					
Likelihood ratio of independence: $\chi2(1)$			36.25***			

Note: *, **, and *** represent significance at the 10%, 5% and 1% levels, respectively.

4.4 | Effect of Household and Farm Characteristics on Smallholder Oil Palm Farmers' Productivity

Table 2, columns 4 (land leasing participating farmers) and 6 (land leasing non-participating farmers), showed that the likelihood ratio tests for joint independence of the equations in the ESR model were dependent. The Table and columns reveal that for participating and non-participating farmers, the correlation coefficients ρ_1 and ρ_2 were individually statistically significant, signifying that there was an existence of choice bias in land leasing status due to unobservable factors. The ESR model, which considers both observable and unobservable issues, is suitable for this study, as employed by [27] in his study on the irrigation effect on crop efficiency in Tigray, Ethiopia. However, ρ_1 was negative while ρ_2 was positive, showing that land-leasing participating farmers had higher productivity than a random farmer from the sample, while land-leasing non-participating farmers had lower productivity than a random farmer from the sample. *Table 2* shows the evaluation of the outcome equation: columns 4 and 6 for participating and non-participating farmers, respectively, reveal the effects of Household- and farm-level characteristics of smallholder oil palm farmers on their productivity. The effect evaluation in the Table and columns reveals that Gender, marital status, access to credit, association/cooperative membership, and family labour were positively significant, increasing the productivity of smallholder oil palm farmers among the participating farmers (column four). It suggests that the higher these variables, the higher the productivity of smallholder oil palm farmers among participating land-leasing farmers.

Being a male smallholder oil palm farmer would increase the productivity of participating smallholder oil palm farmers. It supports the findings of [28] in their research on motivating farmers in the Netherlands to increase soil organic matter: the more male farmers, the higher the farmers' collective productivity, due to their strength and vigour in farm work. The marital status was significantly different from zero, with a positive coefficient, suggesting that being married would increase the productivity of smallholder oil palm farmers among land-leasing participants. It buttresses the findings of [29].

Access to credit facilities was positively associated with the land-leasing participating farmers. It suggests that access to credit by smallholder oil palm farmers participating in the land leasing market scheme will likely increase their productivity. It confirms the findings of [30], which stated that there is a high relationship between access to credit facilities and farmers' productivity. Membership in an association or cooperative was significantly different from zero among participating land-leasing farmers. It presume that land leasing market scheme participating smallholder oil palm farmers who belong to an association or cooperative society will likely have higher productivity than those who are not a member of any association or cooperative, this supports the findings of [13] that membership of an association or cooperative society increases farmers access to financial assistance and access to farm inputs at a cheaper price. The value of family labour was significantly different from zero among participating smallholder oil palm farmers who leased land. It shows that the more family labour, the higher the productivity of land leased by participating smallholder oil palm farmers. According to [31], family labour will cut down the production cost, which will lead to an increase in the farmers' productivity in the long run.

Household size and fertilizer application negatively and significantly reduced smallholder oil palm farmers' productivity among the land-leasing participants. It suggests that increases in household size and fertilizer application will likely reduce the productivity of smallholder oil palm farmers participating in the land-leasing market scheme. The larger the household size, the higher the likelihood of a higher marginal propensity to consume. So, there is a likelihood of a decrease in the productivity of smallholder oil palm farmers due to land leasing. It supports [32]'s findings from a study in Pakistan on the food security of smallholder farmers' households. Fertilizer application also exhibited a negative and significant relationship with the productivity of participating farmers in land leasing. It suggests that an increase in fertilizer use will reduce the productivity of participating farmers in land leasing. It buttresses the findings of [33] in his study on "Mineral nutrition and fertilization of some crops' in Colombia" that application of fertilizer to crops' should be done under the guidance of an extension officer, because different crop needs different Quantity of fertilizer at a particular point in time, so application of too much fertilizer on some crops could be inimical to farmers' productivity.

Age, years of experience, and herbicide use positively and significantly increased the number of smallholder oil palm farmers among land-leasing non-participating smallholder oil palm farmers. The positively significant coefficient for age among land-leasing non-participating smallholder oil palm farmers indicates that as age increases, productivity is more likely to increase. This buttresses [34] 's assertion that age is among the factors that positively influence farmers' productivity. The positive coefficient for education level in the outcome equation for the land leasing non-participating smallholder oil palm farmers specification suggests that the higher the level of education, the greater the likelihood of an increase in their productivity. According to [35], education enables farmers better to use research findings and technology in crop production, thereby enhancing their productivity. It supports the findings of [36] regarding the effect of agricultural education on farmers' productivity in Ghana.

The value for the Quantity of herbicide used was positive and statistically significant for land leasing non-participating smallholder oil palm farmers, suggesting the positive impact of the Quantity of herbicide on smallholder oil palm farmers' productivity. The more herbicides the land leasing non-participating smallholder oil palm farmers use to control weeds on their farm, the more likely their productivity is. Since the cultivated land will likely be small hectares, herbicide use will be efficient, enhancing productivity. It supports the assertion of [37] that the appropriate use of herbicides, based on agricultural best practices, will enhance farmers' productivity. Farm size negatively and significantly induced non-participating farmers' productivity. It implies that an increase in farm size among non-participating smallholder oil palm farmers will reduce their productivity. Since they are not participating in the land-leasing market scheme, they will likely cultivate a small farm.

4.5|Evaluating the Effect of Land Leasing Market Scheme on Smallholder Oil Palm Farmers' Productivity

Household and farm features could influence the productivity of smallholder oil palm farmers. It was addressed by evaluating an ESR model, which enabled the construction of a valid counterfactual hypothetical case of land-leasing smallholder oil palm farmers, both participating and non-participating. *Table 3* shows the effect of the land-leasing market scheme on smallholder oil palm farmers' productivity from ATE in the Treated evaluations of the ESR model specifications. To evaluate the impact of the land-leasing market scheme on smallholder oil palm farmers' productivity, the ATE for the expected outcome was estimated. It is important to note that ATE evaluation considers other confounding factors, such as choice bias arising from possible differences between land-leasing participants and non-participants, and smallholder oil palm farmers, as opined by [38].

The results revealed that participation in land leasing significantly increased smallholder oil palm farmers' productivity. To be specific, the expected FFB from land leasing participating smallholder oil palm farmers was 2,946.4 kg/hectare compared with 2,042.0 kg/hectare from land leasing non-participating smallholder oil palm farmers. This variance indicates a 30.70% increase in the productivity of smallholder oil palm farmers

participating in the land-leasing market scheme. The variance in the expected productivity of land leasing market scheme participants and non-participants was significant at 1% level of significance. It corroborates the findings of [39] that the more land that is available for crop cultivation, the higher the productivity of the farmers.

Table 3. Impact of land leasing.

	Oil Palm			
Variable	**Land Leasing (Kg/Ha)**	**Land Non-Leasing (Kg/Ha)**	**ATE T-test**	**Net Change %**
Productivity	2,946.4	2,042.0	7.9***	30.7

Note: *** represents significance at 1% levels

5 | Conclusion

The study evaluated how participation in the land-leasing scheme affects the profitability and productivity of smallholder oil palm farmers in Nigeria's oil palm-producing belt. As shown in the study, participation in the land-leasing market scheme increases the profitability and productivity of smallholder oil palm farmers among respondents. The government at all levels has put in place several programs to support tree crop smallholder farmers in Nigeria. However, there is no empirical study on how the land-leasing market scheme increases the profitability and productivity of smallholder oil palm farmers. So, the study adds empirical evidence to the existing literature on how to increase the profitability and productivity of smallholder oil palm farmers in Nigeria and other oil palm-producing countries such as Colombia, Indonesia, and Malaysia. Using NPMR and the ESR model, the analysis showed that smallholder oil palm farmers who leased land for oil palm cultivation had higher profits and higher productivity than landowners.

From the research, the following policy implications can be inferred: first, smallholder oil palm farmers who leased farmland had higher earnings from their venture than those who did not lease their farmland. Therefore, there is a need to sensitize smallholder oil palm farmers to participate in the land leasing market scheme. Secondly, the study revealed that older farmers are unwilling to participate in the land-leasing market scheme. Hence, the government and non-governmental organizations should support youths in participating in the land leasing market scheme. So, it is essential for governments at the local, state, and national levels, in conjunction with national and international non-governmental organizations interested in encouraging youths in agribusiness, to factor the land leasing market scheme into their program frameworks. Thirdly, as shown in the study, farm experience is one of the significant variables that positively influence the profitability and productivity of land-leasing participants. So, smallholder oil palm farmers with up to 10 years of farming experience should be supported to participate in the land leasing market scheme.

Furthermore, as shown in the study, the productivity of the land-lease participating farmers was enhanced through their access to credit facilities and their involvement in associations or cooperative societies. Government credit scheme programs, as well as national and international non-governmental organizations, should consider smallholder oil palm farmers. Financial institutions should be encouraged to provide credit facilities to smallholder oil palm farmers at single-digit interest rates. It will enhance their ability to participate in the land-leasing market scheme to cultivate oil palm and to buy fertilizer and other inputs, thereby increasing their productivity. Again, in Nigeria and most oil palm-producing countries, there are oil palm farmers' associations; therefore, smallholder oil palm farmers should be encouraged to join the associations.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability

All data are included in the text.

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