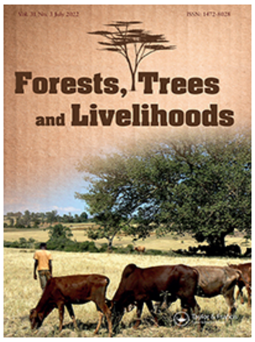

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Adebayo B. Aromolaran[a], Abiodun E. Obayelu[b], Milu Muyanga[c], Thomas Jayne[c], Adesoji Adelaja[c], Titus Awokuse[c], Omotoso O. Ogunmola[d], and Olatokunbo H Osinowo[e]

[a]Department of Agricultural Economics, Adekunle Ajasin University, Nigeria; [b]Department of Agricultural Economics & Farm Management, Federal University of Agriculture, Abeokuta, Nigeria; [c]Department of Agricultural, Food and Resource Economics (AFRE), Michigan State University (MSU), East Lasing, USA; [d]Department of Agricultural Economics, Bowen University, Iwo, Nigeria; [e]Department of Agricultural Economics & Farm Management, Olabisi Onabanjo University, Ago Iwoye, Ogun State, Nigeria

ABSTRACT

Decision-making is central to farm management. This study assesses key factors influencing land allocation decisions of households with respects to tree crop cultivation in Nigeria. The study uses primary data collected electronically from a sample of 569 small and 495 medium-scale farmers in Ogun State.Tobit and Heckman regression models were estimated. The study finds that, farm households who have access to land markets and land tenure security, all-weather roads, agro-dealer services and better transportation services are more likely to cultivate tree crop fields and allocate a higher share of total farm holdings to tree crop enterprises. Farm households with more educated heads put larger area of land under commercial tree crop cultivation and those with larger off-farm income tend to cultivate less hectarage to tree crops. The share of farmland allocated to tree crops by male headed households is higher than the share by the female headed households. In addition, female and youth-headed households were found to be less likely to invest in commercial tree crop farming. Policies and intervention programs that would enhance access to land, agro-dealer services, all-weather roads, transportation services and security of land tenure could facilitate the redistribution of land in favour of commercial tree crops.

KEYWORDS
Agricultural lands; commercial tree crops; farm households; land allocation decision; rural development

Introduction

In Nigeria, tree crops are the second largest foreign exchange earner (after crude oil) as well as being the most important agricultural export subsector. Since the early 1970s, Nigeria has run a mono-product economy with heavy reliance on oil; leaving the country vulnerable to oil price shocks as a result. The latest shock came in February 2020, when crude oil prices crashed amid the global COVID-19 outbreak. Figures released by the Nigerian Bureau of Statistics on 31 August 2016 showed negative growth rates for the first and second quarters of that year and indicated that Nigeria was officially in recession for the first time since 1987.

CONTACT Abiodun E. Obayelu obayeluae@funaab.edu.ng; obayelu@yahoo.com
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In response to this 2016/2017 economic recession triggered by a crash in oil prices, the Nigerian Export Promotion Council (NEPC) developed the zero-oil plan (ZOP) as a core component of the government's Economic Recovery and Growth Plan (ERGP). The ZOP, which was launched by the Federal Government of Nigeria in October 2016, is an export diversification strategy aimed at increasing the global market share of Nigeria's non-oil products and thereby boosting foreign exchange throughout the non-oil sector. The plan prepares Nigeria for a world in which crude oil is less relevant and could generate up to $30 billion per year in foreign exchange from non-oil exports as opposed to the current earnings of $5 billion. The ZOP is also projected to add an extra $150 billion minimum to Nigeria's foreign reserves cumulatively over the next 10 years from non-oil exports, create at least 500,000 additional jobs annually and lift at least 20 million Nigerians out of poverty. A major strategy of ZOP is using hectarage expansion to increase production of these selected high value agricultural products for which Nigeria currently has comparative advantage in the international market.

The more a farmer is aware of the decision-making processes that affect farm and household, the more sustainable the enterprise will be and the more likely it will be profitable and sustainable (Aromolaran et al. 2020). This paper seeks to empirically identify the key factors that influence the land allocation decisions of farm households in Nigeria; with special emphasis on tree crops. This study specifically explores whether the reallocation of land from arable crops to tree crops is associated with differences in key farm, household, land ownership, human capital, assets, input market, product market, infrastructure, information and support services and if these differ between small-scale farm households (SSFHs) and medium-scale farm households (MSFHs). SSFHs are defined in this study as those that operate on less than 5 ha, whereas MSFHs operate on between 5 and 100 ha (Jayne et al. 2019).

The study investigated two key hypotheses.

H_1: There is no significant relationship between the share of land allocated to tree crops and market access, human capital, knowledge acquisition and dissemination, land ownership, tenure security, household head characteristics and size of land cultivated.

H_2: Land area under commercial tree crops plantation is not significantly influenced by market access, human capital, knowledge acquisition and dissemination, land ownership, tenure security, household head characteristics and size of land cultivated.

Motivating factors and contributions of the study

In developing countries facing high levels of food insecurity, such as Nigeria, decision to plant tree crops is a gradual process that affect food supply and food availability. Farmers' decision to expand their farm are more importantly affected by land availability, financial assets (household wealth status) and other socioeconomic characteristics of the farmers such as farming experience, access to agricultural extension services, access and availability of labor services and farming systems. But there are few empirical studies on the drivers of farm households' decision to expand their farm land area under commercial tree crop plantation as a way of transition from small-to-medium scale farms. A better understanding of specific factors that limit farmers' land allocations decision is crucial in order to effectively prepare policies, development strategies, programmes and models aimed at supporting and enhancing commercial agricultural farming through planting of commercial tree crops. An assessment of the factors that drive land allocation decisions could yield useful policy insights into how to boost tree crop cultivation and by extension, serve as an important pathway to livelihood improvements to rural households.

Findings from this paper are also expected to contribute to the literature and debate on the "right" strategy for agricultural transformation in Nigeria with emphasis on the dynamics of scale of farm operations as well as promote discussion, debate and the exchange of information on issues relating to rural development.

Theoretical framework

According to Nkonya et al. (2005), agricultural land allocation decision-making is derived from the basic economic theory of household utility related to farm production and management. These decisions necessitate crop choices and cropland allocation with implications for farm households' crops diversification level. In a number of studies, households' tree planting behaviour and land allocation decisions have been investigated and analysed under different theoretical frameworks such as neo-classical theory (Amacher *et al.* 2004), applied neo-classical theory (Cooke *et al.* 2008), utility maximisation theory (Bluffstone *et al.* 2008), and applied modified rational choice theory (Doss 2006).

Specifically, the theoretical framework used in this study is adopted from Diogo et al. (2015) and is an economic theory-based explanatory model of agricultural land use patterns stating that when making land use decisions, farmers pursue utility maximisation in agricultural production systems while considering alternative production options. Under this framework, it is assumed that land is allocated to the use for which the landowner (farmer) will have the largest discounted present value of expected future net returns (greater perceived utility). If land can be allocated to either of two uses, i and j, land site k will be used for i (e.g. tree crops) when the present value of expected future returns (perceived utility) of the land use for i (V_{kit}) is greater than the present value of expected future returns for j (V_{kjt}) (Ngwira et al. 2014).

That is: $V_{kit} > V_{kjt}$; where V_{kjt} is the present value of expected returns for land at site k, put into use j, at time t.

V_{kt} is assumed to depend on a complex combination of factors that together set the opportunities and constraints for different production options or land use type. In the reviewed literature, several factors have been identified to explain decision of farmers on land use. These factors include soil quality, farm size, farm labour, level of household head education, household head farming experience, land tenure security, distance to market, farm age, off-farm income, initial wealth status of households, access to credit, and technical knowledge (Browder et al. 2004).

The theoretical literature provides some explanations as to why certain factors could significantly influence farmers' land use decisions (see Hettig et al. 2016). Firstly, factors like the degree of tenure security, the accessibility to public services/markets centres and transport infrastructure can influence land use decisions by enabling rural households to improve their access to agricultural inputs and/or sell their products. Secondly, farmers' characteristics and endowments (Bergeron and Pender 1999) are key parameters in land use decisions through their effect on the adoption of technologies and crop management strategies. For example, a higher level of wealth increases access to capital and enables a household to invest in more capital-intensive land use. Thirdly, the quality of input and output markets might play a very basic role in the land allocation decision process of farm households. Households' land allocation decisions could differ if markets for labour and agricultural inputs are limited or even non-existent (Hettig et al. 2016). For example, cash crop adoption and/or agricultural land expansion is more restricted for households in areas with fragmented markets. In addition, if input and/or output markets are limited or non-existent, households might have to fall back on family workforce and capital endowments.

The determinants of crop choice and cropland allocation decisions have also been hypothesised to change with variations in the characteristics observed in households (e.g. gender, age and education of household head, household labour endowment, household's endowments of physical assets such as farm size, livestock, household access to credit and attitude towards risk) and land characteristics or plot-level factors such as soil type, soil fertility level, slope of the plot, plot distance from home, tenure security (Bergeron and Pender 1999), crop varietal characteristics (Smale et al. 1994), production risks (Kurukulasuriya & Mendelson 2008), price risks (Collender and Zilberman 1985), institutional (policy) level factors such as fertiliser subsidy program, farmer organisations, access to produce, input and credit markets and public infrastructure such as all-weather roads.

In terms of estimation methods in the literature, Tobit and Heckman regression models have been widely used to model the land allocation decisions of farmers in crop production. For instance, while Coxhead and Demeke (2004) used the Tobit model to estimate cropland allocation decisions for upland agricultural households in Philippines using panel data, Mponela et al. (2011) used the same regression model on cross-sectional data to analyse factors that influence households' land allocation decisions to cultivate Jatropha curcas.

On the other hand, Sikor and Baggio (2014) employed the Heckman regression model to examine the possibility that smallholders engage in tree-crop plantations as a potential means for poverty alleviation in rural Vietnam, while Kulindwa (2016) used this same model (Heckman) to analyse factors that drive tree planting behaviour in Tanzania. In this study, we consider factors influencing joint decisions of the farm households on whether to use their land to grow tree crops and how much land to use using the Tobit and Heckman regression model following Dashti et al. (2017). Some of the specific questions this paper addresses are as follows: (i) Is the reallocation of land devoted to tree crops vis-a-vis arable crops by farm households associated with differences in access to land, hired labour, production inputs, market infrastructure, information and knowledge? (ii) Is the decision to expand land area under commercial tree crops dependent on human capital endowments, household physical/financial asset base, household head characteristics, and land ownership status? (iii) Are there differences in factors that influence land allocations decisions of SSFHs and MSFHs?

Methodology

Data and variables description

A multi-stage sampling procedure combining purposive, cluster and proportionate random sampling techniques were utilised to select a sample of 519 medium-scale farm households (MSFHs) and 575 small-scale farm households (SSFHs). In the first stage, Ogun State was purposively selected because over the past two decades, the state has made giant strides in providing the necessary policy environment for the development of commercial agriculture. For example, the state was one of the 14 states in Nigeria that provided land for the establishment of production clusters under the Federal Government Agricultural Transformation Agenda (2011–2015). Two, in 2008 Ogun State Ministry of Agriculture created a Department of Tree Crops and Rural Development Services, mandated to position the state as the number one producer of tree crops in Nigeria for carbon sequestration, to facilitate livelihood enhancement for tree crop farmers in the state and to encourage youth engagement in tree crop farming. Third, recognizance survey results for this study also revealed that about 36% of land cultivated in Ogun State is devoted to tree crops and the remaining 64% to arable crops which still underscores the importance of tree crops in the cropping system of the state. In the second stage, all the Local Government Areas (LGAs) in Ogun State were clustered by senatorial districts and one LGA purposively selected per cluster based on land size and high concentration of farming households. This resulted in the selection of Ijebu East, Imeko Afon and Obafemi Owode LGAs from Ogun East, West and Central senatorial districts, respectively (Figure 1). In the third stage, four wards from

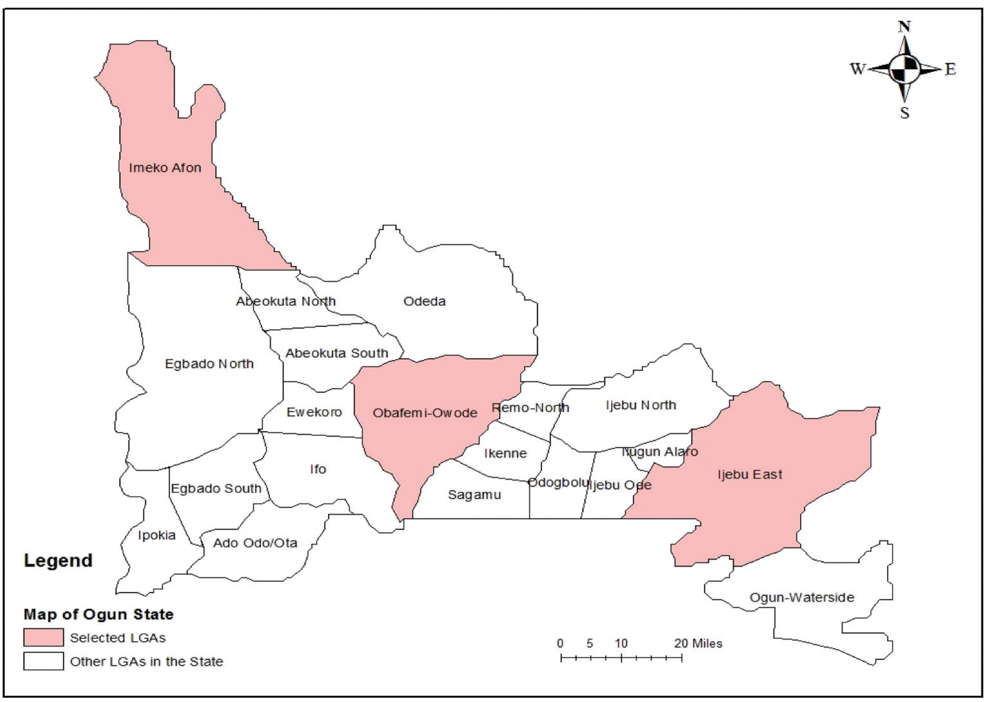

Figure 1. Map of Ogun State, Nigeria, showing APRA study LGAs. Source: Authors' own.

each LGA in Ogun State were selected using a combination of cluster and random sampling. Proportionate random sampling was then used to select 519 MSFHs and 575 SSFHs across Ogun State, respectively. Although, due to missing data in certain cases, only 495 MSFHs and 569 SSFHs were ultimately analysed. Data collection was cross-sectional in nature and was carried out with the aid of a structured electronic questionnaire. The trained enumerators for the survey used 'Survey Solutions', an android-based computer-assisted personal interview (CAPI) software developed by the World Bank for the administration of the questionnaire with their android tablets provided to them for the survey.

Description of model variables

The summary of key variables used in this study is found in Table 1. The descriptive statistics presented in Table 1 showed that, only 25.7% of SSFHs and 57.37% of MSFHs own tree crop plantations. The average cultivated size is 2.28 ha for SSFHs and 11.4 ha for MSFHs. The share of tree crops in total cropped land is 16% for SSFHs and 36.7% for MSFHs. Furthermore, among tree crop farmers alone, land area under tree crops averages 2.79 ha for SSFHs and 12.23 ha for MSFHs. Thus, tree crop cultivation as a pathway to agricultural commercialisation in the study area seems to be more predominant with MSFHs than SSFHs. The data also shows that farm size of the average SSFH is 4.05 ha compared with 18.02 ha for MSFHs. Thus, SSFHs are currently cultivating about 56% of their farm area compared with 62.6% for MSFHs. This implies that the average farm household still has a substantial amount of un-utilised or unoccupied land for expansion if production and marketing environment is enhanced by appropriate policy.

The data also shows that 23.6% of all farm households (16.5% and 31% respectively for SSFHs and MSFHs) are natives (with land which is neither government land nor freehold but owned by the indigenes). The percentage of farmers who own their land is around 76.3% (74% and 79%, respectively for SSFHs and MSFHs), while those with land title ownership (an official right that strengthen ownership) is only 3% among farm households (0.7% and 5.7%, respectively for SSFHs and MSFHs) in the study area. This shows that the majority of farmers who own their land have very weak tenure security since they lack a title, especially among SSFHs. We observe that access to machinery services is also very low and stands at 6.2%. However, access is higher among MSFHs (10%) relative to SSFHs (3%). Access to fertiliser is also low at 24% but this is substantially higher among MSFHs (36%) than among SSFHs (14%). Access to extension services is very low at about 13%, but higher for MSFHs (19%) than for SSFHs (7%). Access to agro-service dealers and established markets is low at 26% and 47% respectively and do not differ substantially between MSFHs and SSFHs. In addition, only 13.3% of households' use hired labour on their farms. This is an indication of inefficient labour market function, which has serious implications for hectarage under crop production.

Empirical strategy

Tobit model specification

To investigate the factors that determine land allocation decisions, we adopt an aggregate land allocation model described by Miller and Plantinga (1999), which has been used by a number of economists in dealing with estimations of factors influencing share of land allocated to various uses (e.g. Mu and McCarl 2011). The expected share of any crop is

Table 1. Description of key variables in the models for the study.

Variable	Description	Average values for SSFHs	Average values for MSFHs
Dependent Variables			
Share of tree crops in total farmland (per cent)	Continuous	0.1611	0.3659
Own tree crops	Own tree crops field = 1	0.2566	0.5737
Size of tree crop farm (ha)	Continuous	2.7932	12.4325
Household characteristics (Explanatory Variables)			
Age	Age of the household head in years	49.098	50.589
Sex	If household head is male = 1, otherwise = 0	0.926	0.949
Marital Status	If the household head is married = 1, otherwise = 0	0.914	0.933
Education	Years of formal education of the household head	6.569	7.830
Dependency Ratio	Ratio of non-working members to working members of the household	4.10	2.10
Access to machinery services	If having access to machinery services like tractor or other machines = 1, otherwise = 0	0.028	0.101
Native	If household head is a native of the community = 1, otherwise = 0	0.165	0.317
Experience in farming	Number of years household head has been farming	19.264	21.087
Access of fertiliser	If having access to fertiliser use = 1, otherwise = 0	0.144	0.360
Livestock ownership	measured as tropical livestock unit (TLU)	0.019	0.025
Family labour access	If household uses only family labour = 1, otherwise = 0	0.754	0.638
Hired labour access	If household uses some hired labour	0.156	0.105
Hired labour (person-days per ha)	Continuous	125	115
Land Ownership Status	If household owns at least half of the land cultivated = 1, otherwise = 0	0.738	0.792
Area cultivated (Ha)	Size of the farmland being cultivated by household in hectares	2.278	11.142
Access to extension services	If there are extension visits to the household farms or by household members during last 1 year = 1, otherwise = 0	0.074	0.188
Land title ownership	Own land title = 1, otherwise = 0	0.738	0.057
Access to all-weather road	Access = 1, otherwise = 0	0.875	0.891
Access to agro-service dealers	Access = 1, otherwise = 0	0.237	0.279
Access to established markets	Access = 1, otherwise = 0	0.527	0.412
Access to traders with large vehicles	Access = 1, otherwise = 0	0.406	0.416
Off farm Income	Continuous variable	216.20	377.82
Land area under household control	Continuous	4.05	18.02

(*Continued*)

Table 1. (Continued).

Variable	Description	Average values for SSFHs	Average values for MSFHs
Value of farm assets in terms of equipment	Continuous	11.96	31.12
Value of home assets	Continuous	131.91	606.34

Source: Data from Field Survey, April/May 2018

estimated by specifying its probabilities as influenced by a vector of explanatory variables (Miller and Plantinga 1999). Specifically, we use the Tobit regression model to explain the decisions of farm households with regard to the share of total cropland allocated to tree (permanent) crops relative to arable (annual) crops. This limited dependent variable regression model was specified to jointly estimate the roles of factors affecting farmers' decisions on the proportion of land to allocate to the cultivation of tree crops vis-a-vis arable crops together with a set of explanatory variables. The formula as adapted from Greene (2002) is:

$$Y_i^* = X_{ij}\beta_j + \varepsilon_{i,} \tag{1}$$

$$Y_i = Y_i^* if Y_i^* > 0, \tag{2}$$

$$Y_i = 0 if Y_i^* \leq 0, \tag{3}$$

$$Y_i = X_{ij}\beta_j + \varepsilon_{i,}\ i = 1, 2, 3 \ldots\ldots. n,\ \mathrm{k} = 1, 2\ldots\ldots\ldots.\mathrm{m} \tag{4}$$

Note that Y_i is observable and Y_i^* is a latent dependent variable. A latent variable can be observable whenever it is positive. Once the latent variable is negative, the observation becomes censored and one can simply observe $Y_i = 0$. In this study, the data are left censored. The subscript i is used to index the observations of the sample with the total number of observations denoted by n. X_j is the vector of explanatory variables, β_j is a vector of unknown coefficients to be estimated and ε_i is an independently distributed error term or unobservable variable that affects Y_i^* and is assumed to be normally distributed with a zero mean and constant variance. The hypothesised explanatory variables,X_j, are described in Table 1.

Specification of the heckman model

Secondly, the decision of farm households to increase or decrease land area under permanent crops is modelled using the Heckman two-stage approach. The Heckman model is based on the assumption that area cultivated to tree crops follows a two-stage decision process which includes the decision to either allocate or not allocate land to tree crops, followed by the decision on the size of land to be committed to tree crops.

To implement the two-step Heckman's approach, the first step is the selection equation, which explains factors influencing a farmer's decision to use his/her land to cultivate tree crops or not, using the probit regression analysis specified as follows:

$$Y_i = X_{ij}\beta_j + \varepsilon_i \tag{5}$$

In the first step, dependent variable Y_i is modelled as a binary choice variable, equal to 1 if a farmer owns a tree crop enterprise and zero otherwise. The outcome equation (second stage) explains the effects of a hypothesised set of j factors (X_j) on the size of land devoted for tree crops. Thus, in the second stage, the Heckman model estimates the factors that affect the size of land cultivated under tree crops. In addition, the value of Inverse Mills Ratio (IMR) is used to correct for selection bias.

The outcome equation is estimated by employing ordinary least squares (OLS) as follows.

$$A_i = \alpha_0 + a_j X_{ij} + IMR_{ij} \tag{6}$$

The dependent variable, A_i, for the outcome model (equation) is the size (ha) of land used in cultivating tree crop. The hypothesised model explanatory variables for both stages of the Heckman model X_{ij} are as described under the Tobit model specification above. If the value of the IMR is significant and positive, it means that error terms of both selection equation and outcome equation are positively correlated. Hence, the presence of sample selection bias justifies the use of Heckman's two-stage model.

Results and discussion

Commercialisation indices of crops and crop groupings in the study area

Table 2 shows the Crop Commercialisation Index (CCI) is only slightly higher for the tree crops (0.97) compared with arable/annual crops (0.94) in the study area. Thus, crop farming in Ogun State, be it for tree crops or for arable crops, is highly commercialised. Furthermore, we observe that tree crop cultivation is more predominant among MSFHs, compared with SSFHs. Specifically, Table 2 shows that the share of cultivated land devoted to tree crops is 40% and 19% respectively for MSFHs and SSHFs respondents.

Determinants of the decision to allocate land to tree crops

A two-stage Heckman selection model was used to investigate factors that influence decision to allocate and the actual size of farmland put under tree crop cultivation. The result of the selection equation is presented in Table 3, while that of the outcome equation is presented in Table 4.

The overall significance level of Heckman selection (probit) at 1% implies that the model was acceptable in showing the variation in farm household decisions by the explanatory variables. The Wald test is significant at 1% level. This indicates that as a whole, our model fits significantly better than an empty model (that is, a model with no predictors). To test the validity of the exclusion restriction variable(s), we dropped access to machinery and fertiliser which are significant in the probit model (selection model) and non-significant in the outcome model. This result is consistent with the principle of exclusion restrictions when estimating the Heckman model (Zhang et al. 2019). The significance of Mill's ratio generated by the probit model as an additional explanatory variable shows that factors influencing decisions to either allocate or not allocate land to permanent crops are not identical with factors determining the amount of land put under tree crops cultivation. Logically, then, using the Heckman two-stage process is appropriate for this study. This

Table 2. Share of land area cultivated and Crop Commercialisation Index (CCI) of tree crops (permanent crops) and arable (annual) crops by scale of farm in Ogun State.

	MSFHs N = 2,217			SSFHs N = 1,345			Pooled N = 3,562		
Crop Grouping	Land area cultivated^{+} (ha)	Share of total^{++}	CCI	Land Area cultivated	Share of total	CCI	Land Area cultivated	Share of total	CCI
Cashew	228.84	0.11	0.97	37.84	0.15	1.00	266.68	0.11	0.98
Citrus	42.01	0.02	0.92	0.70	0.003	1.00	42.73	0.02	0.93
Cocoa	1500.08	0.69	0.97	196.57	0.78	0.99	1696.66	0.70	0.97
Guava	1.20	0.001	1.00	-	-	-	1.2	0.00	1.00
Coconut	0.40	0.00	1.00	-	-	-	0.4	0.00	1.00
Oil palm	120.26	0.06	0.91	2.29	0.01	0.51	122.54	0.05	0.86
Kolanut	275.41	0.13	0.99	13.29	0.053	1.00	288.70	0.12	0.99
Tree Crops	**2168.22**	**0.40**	**0.97**	**250.69**	**0.19**	**0.98**	**2418.91**	**0.36**	**0.97**
Cereals	773.332	0.243	0.96	282.75	0.267	0.92	1056.08	0.25	0.95
Legumes	144.82	0.045	0.96	16.10	0.015	0.93	160.92	0.04	0.96
Starch/ Sugars	1922.311	0.603	0.94	666.17	0.629	0.93	2588.48	0.61	0.94
Arable Fruits/ Nuts	74.225	0.023	0.54	1.81	0.002	0.99	76.04	0.02	0.55
Horticulture	272.736	0.086	0.95	92.69	0.087	0.95	365.43	0.09	0.95
Arable Crops	**3187.42**	**0.60**	**0.94**	**1059.52**	**0.81**	**0.93**	**4246.94**	**0.64**	**0.94**
All Crops Total^{+++}	**5355.64**	**1.00**	**0.94**	**1310.21**	**1.00**	**0.93**	**6665.85**	**1.00**	**0.94**

Note: N is the total number of cultivated plots, $^{+}$ is the total land area cultivated of each crop, $^{++}$ is the total amount of land allocated to produce crop j to "total crop land operated by the farm household", $^{+++}$ computation include those that intercrop trees with arable crops, CCI is computed as percentage of total output produced by household that is sold.
Source: Data from Field Survey, April/May 2018

procedure was followed to ensure that the model is well identified, thereby avoiding multi-collinearity problems.

The decision to allocate cropland to tree crop cultivation is positively influenced by five factors; namely gender of household head, access to land markets, land ownership, access to all-weather roads and value of farm assets owned (see Table 3). In addition, the results also suggest that the decision is negatively affected by three factors; namely access to fertiliser, hired labour and machinery services.

Firstly, results show that farm households headed by males are 16% and 30% more likely to own tree crop fields compared to those headed by females across SSFHs and MSFHs respectively. This result is in agreement with Embaye et al. (2018), who found a positive and significant relationship between gender and land allocation decisions relating to oilseed tree crop. This result reflects the importance of gender factors in the decisions to cultivate permanent crops, with women in our sample being more likely to cultivate arable crop farms probably because of the dual purpose it serves, for both food and cash.

Secondly, we find that ownership of farmland increases the likelihood that MSFHs and SSFHs will allocate land to commercial tree crops by 38% and 13% respectively. This correlates with other studies (such as Gebreegziabher et al. 2010; Kulindwa 2016) that have shown that land ownership is a significant factor influencing farm households' decision to cultivate tree crops. This result is reasonable given the fact that tree crops are permanent crops and can remain on the land for decades once established. This effect can be attributed to the increased sense of security that ownership of land confers on farm households. We also find that access to all-weather roads significantly affects commercial tree crops land allocation decisions among SSFHs – but not with MSFHs. We observe that SSFHs with access to all-weather roads are 12% more likely to allocate farmland to commercial tree crops.

Table 3. Determinants of farm households' decision to allocate land to tree crops.

Cultivate permanent crops (yes = 1)	Total sample	P>|z|	Marginal Effect	Small-scale	P>|z|	Marginal Effect	Medium-scale	P>|z|	Marginal Effect
Education (in years)	−0.0079 (0.0091)	0.385	−0.0030	−0.0372** (0.0156)	0.017	−0.0123	0.0017 (0.0128)	0.895	0.007
Access to Land Market	0.4319*** (0.0915)	0.000	0.1664	−0.1589 (0.1662)	0.339	−0.0513	0.2646** (0.1297)	0.041	0.1047
Access to Hired labour	−0.1209 (0.1236)	0.328	−0.0457	−0.0379 (0.1711)	0.824	−0.0124	0.0133 (0.2081)	0.949	5.28E-03
Off-farm Income	−0.00003 (0.00008)	0.668	−0.00001	−0.00004 (0.0002)	0.870	−0.00001	−7.86E-07 (0.00009)	0.993	−0.00003
Land Ownership	0.8715*** (0.1097)	0.000	0.2978	0.4220** (0.1682)	0.012	0.1301	1.0214*** (0.16150	0.000	0.3842
Land Area Under Control	−9.4E-06 (2.1E-05)	0.656	−3.61E-06	0.0355*** (0.0109)	0.001	0.0117	−0.00001 (0.00005)	0.780	−5.61E-06
Value of Farm Assets	0.0039*** (0.0013)	0.002	0.0015	0.0194*** (0.0055)	0.000	0.0006	−0.0010 (0.0010)	0.329	0.0004
Value of Home Assets	−0.00008 (0.0001)	0.442	−0.00003	−0.0004 (0.0004)	0.266	−0.0001	0.0003* (0.0001)	0.055	−0.0001
Access to Extension Service	0.1804 (0.1316)	0.170	0.0702	0.1177 (0.2478)	0.635	0.0401	0.1798 (0.1733)	0.299	0.0706
Access to Agro-dealer	0.0128 (0.0941)	0.892	0.0049	0.0313 (0.1457)	0.830	0.0103	0.0433 (0.1453)	0.766	0.0171
Access to all-weather Road	0.3005** (0.1296)	0.020	0.1104	0.3852* (0.2058)	0.061	0.1151	0.2493 (0.2013)	0.216	0.0992
Sex (male = 1)	0.6041*** (0.1909)	0.002	0.2053	0.6178** (0.2880)	0.032	0.1673	0.7805*** (0.3031)	0.010	0.2955
Access to large haulage Vehicles	0.0760 (0.0838)	0.364	0.0292	0.2253 (0.1227)	0.066	0.0754	0.0174 (0.1286)	0.892	0.0069
Access to Fertiliser (access to fertiliser = 1)	−0.3855*** (0.1072)	0.000	−0.1423	−0.2998 (0.1927)	0.120	−0.0922	−0.8155*** (0.1418)	0.000	−0.3165
Access to Machinery (access = 1)	−0.6660*** (0.2046)	0.001	−0.2225	−0.6343 (0.4727)	0.180	−0.1666	−0.7715*** (0.2359)	0.001	−0.2949
Youth (youth = 1)	−0.2414 (0.1297)	0.063	−0.0897	−0.0280 (0.1736)	0.872	−0.0092	−0.3975* (0.2179)	0.068	−0.1574
Constant	−1.8074*** (0.2481)	0.000		−2.0036*** (0.3748)	0.000		−1.3296*** (0.3981)	0.001	
Log Likelihood	−644.976			−291.6908			−273.06979		
Number of obs	1060			568			492		
LR chi^2 (16)	140.76			64.07			124.74		
Prob > Chi^2	0.0000			0.0000			0.0000		
Pseudo R^2	0.0984			0.0990			0.1859		

Note: ***, **, * represents significance at 1 per cent, 5 per cent and 10 per cent respectively; Source: Data from Field Survey, April/May 2018

The results also show that MSFHs that have access to machinery and fertiliser are less likely to allocate land to the cultivation of tree crops. In Table 3, the likelihood that MSFHs will allocate land to commercial tree crops declines by 32% with access to fertiliser and by 29% with access to machinery services. The relatively low use of fertilisers and machinery services for tree crop production compared with arable commercial crops such as maize, cassava and cowpeas may be due to the longer gestation period of tree crops, which implies that funds invested in externally purchased inputs cannot be recouped in the short-term. The result is similar to that detailed in Benin by Adjimoti and Yildiz (2018), who found that access to fertiliser has a positive effect on the share of land allocated to cereals and legumes but a negative relationship with industrial crops such as cotton.

Determinants of actual area of land allocated to tree crops

Table 4 shows that the size of the actual land area allocated to tree crops is positively influenced by access to land markets, access to agro-services dealers and the education level of the household head while it is negatively influenced by off-farm income and

Table 4. Determinants land area under tree/permanent crops.

Share of tree crops	Pooled	P>|z|	Marginal Effect	Small-scale	P>|z|	Marginal Effect	Medium-scale	P>|z|	Marginal Effect
Education (in years)	0.0086*** (0.0033)	0.009	0.0084	0.0203*** (0.0078)	0.010	0.0013	0.0074** (0.0035)	0.034	0.0017
Access to Land Market	0.0697* (0.0397)	0.079	0.0675	0.1938*** (0.0748)	0.010	0.0022	0.1329*** (0.0339)	0.000	0.1144
Access to Hired Labour	−0.1658*** (0.0445)	0.000	−0.1605	−0.1706*** (0.0748)	0.022	−0.0212	−0.1996*** (0.0529)	0.000	−0.0878
Off-farm Income	−0.00006* (0.00003)	0.051	−5.84E-08	−0.00006 (0.0001)	0.528	−0.00002	−0.00006** (0.00003)	0.049	−0.00004
Land Ownership	−0.1403* (0.0717)	0.050	−0.1358	−0.1445 (0.0940)	0.124	0.0375	−0.0502 (0.0610)	0.410	0.1774
Land Area Under Control	2.68E-05 (0.0001)	0.818	0.000026	−0.0002 (0.0003)	0.539	0.0002	−0.0003 (0.0002)	0.224	−0.0001
Value of Farm Assets	0.0003 (0.0004)	0.284	2.80E-07	−0.0011 (0.0036)	0.764	−0.0002	0.0003 (0.0002)	0.264	−0.00003
Value of Home Assets	−0.00001 (0.00004)	0.739	−1.27E-08	−0.00035 (0.00023)	0.126	−0.00006	−0.00003 (0.00004)	0.427	−0.000002
Access to Extension Service	−0.1405*** (0.0422)	0.001	−0.1360	−0.1887* (0.1051)	0.073	−0.0299	−0.1111*** (0.0423)	0.009	−0.0817
Access to Agro-dealer	0.0959*** (0.0329)	0.004	0.0928	0.0741 (0.0656)	0.259	0.0090	0.1210*** (0.0361)	0.001	0.0638
Access to all-weather Road	−0.1073** (0.0522)	0.040	−0.1039	−0.3072*** (0.1056)	0.004	0.0175	−0.0042 (0.0532)	0.937	0.0155
Sex (male = 1)	−0.1830** (0.0919)	0.047	−0.1771	−0.1834 (0.1540)	0.234	0.0416	−0.1471 (0.1033)	0.155	0.1180
Access to large haulage Vehicles	0.0304 (0.0297)	0.306	0.0294	−0.0640 (0.0599)	0.286	0.0195	0.0564* (0.0326)	0.083	0.0217
Youth (youth = 1)	−0.0646 (0.0531)	0.224	−0.0625	−0.0918 (0.0814)	0.259	−0.0096	−0.0850 (0.0650)	0.191	−0.0872
Constant	1.1860*** (0.2292)	0.000		1.5706*** (0.3973)	0.000		0.8065*** (0.1621)	0.000	
Mills									
Lambda	−0.2614 (0.1018)	0.010		−0.3357 (0.1681)	0.046		−0.1908 (0.0685)	0.005	
Rho	−0.7856			−0.8732			−0.6831		
Sigma	0.3327			0.3844			0.2793		
Number of obs	1060			568			492		
Wald $chi^2(16)$	67.96			42.35			84.39		
Prob > chi^2	0.0000			0.0001			0.0000		
Pseudo R^2	0.1425			0.1407			0.1349		
R-sqr	0.1088			0.0720			0.1566		
Adj R-sqr	0.0968			0.0485			0.1319		

Note: ***, **, * represents significance at 1 per cent, 5 per cent and 10 per cent respectively
Source: Data from Field Survey, April/May 2018

access to hired labour. As expected, this table confirms the results of the Tobit model regarding factors influencing the share of farmland allocated to tree crops using the same dataset.

More specifically, we find that farm households (irrespective of scale of operation) who have access to land will put about 0.17 ha more land under tree crops than those without access to land. The result shows that increased access to land either through gift or rent could play an important role in expanding the land area under commercial tree crop production in Ogun State. The result is in agreement with the findings of Alawode *et al.* (2018), who observed that improved access to land through rent could increase the level of commercialisation of crops by farmers.

The coefficient of education is positive and significant for both MSFHs and SSFHs. This shows that more highly educated household heads tend to allocate larger areas of farmland to commercial tree crops. This is in agreement with Mizab and Falsafian (2017), who found that education, has a positive and significant effect on the planting of saffron tree crops in Iran. Mponela et al. (2011) also found a positive effect of education on land allocated to jatropha plant in Malawi among the SSFHs.

The coefficient of access to agro-service dealers by the MSFHs is positive and significant at 1% level. This result shows that MSFHs that have access to agro-service dealers will allocate about 0.12 ha more land to tree crops than those without access (see Table 4). The coefficient of off-farm income is negative and significant at 5% level with MSFHs. This implies that MSFHs with higher off-farm income allocate less land to tree crops. This implies that a form of substitution may exist between off-farm income and income from tree crops. This is possible if tree crop plantations are seen by households as an alternative source of stable income inflow to non-farm income. The effect is not significant for SSFHs. This is in line with Ndayambaje et al. (2012), who found that off-farm/non-farm income has a negative and significant effect on tree planting across farms in rural Rwanda; but differs from Gebreegziabher et al. (2010), who observed that the more exogenous income a farmer has, the more likely they would be to plant trees.

The coefficient of access to extension services is negative and significant at 10% and 1% level among SSFHs and MSFHs respectively. This implies that farmers who have access to extension services allocate less land to tree crops compared to those without access. The effect is stronger with MSFHs than SSFHs.

Conclusion and policy implications

Cocoa, cashew, and oil palm were three of the 11 agricultural products identified as having high potential to generate foreign exchange for the country. Increased cultivation of commercial tree crops is expected to reduce rural poverty through increased income from exports, reduced effects of climate and price shocks on farm household welfare, increased capital accumulation in form of mature trees, and stability of income flow to farm households over a longer term. Our results showed that, despite the fact that arable crops are also highly commercialised in our study area, tree crop cultivation appears to be more popular with MSFHs than SSFHs in the study area. Farm households that are highly educated, have access to land markets, all-weather roads, own land and have more farm assets are more likely to allocate a larger share of cropland to commercial tree crops relative to arable crops.

Some findings of the study are interesting and useful from both policy formulation and intervention perspectives. In order to influence farmers' land allocation behaviour in favour of commercial tree crop agriculture, policies and intervention programmes will have to address the following issues: Firstly, policies must be directed at increasing both access to land and security of tenure as this would positively impact land allocation to tree crops; especially among MSFHs. Secondly, policies that would increase access to agro-dealer services could lead to expansion in land under commercial tree crops enterprise especially among MSFHs. Policy would need to focus on improving the distribution network of agro-chemical products for hectarage expansion under tree crops to become a reality. Thirdly, cultivation of tree crops can be enhanced among SSFHs if policy is directed at improving access to all-weather roads and large haulage vehicles. Fourthly, there is a need for policies that will encourage more women to engage in tree crop farming; especially when it comes to establishment of new plantations, which is a major component of the current Zero-Oil policy (ZOP) strategy aimed at expanding land area under tree crops in Nigeria. Fifthly, there is a need to put in place policies that would encourage increased engagement of youths who are also educated in commercial tree crop production.

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ORCID

Abiodun E. Obayelu http://orcid.org/0000-0003-3328-7717
Thomas Jayne http://orcid.org/0000-0001-8281-4099

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