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EXPANDING LAND AREA UNDER COMMERCIAL TREE CROP PLANTATION IN NIGERIA

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ACRONYMS

APRA	Agricultural Policy Research in Africa
CCI	crop commercialisation index
LR	Likelihood ratio
LGA	local government area
MSFH	medium-scale farm household
MSF	medium-scale farm
SSFH	small-scale farm household
SSF	small-scale farm
ZOP	Zero-Oil Plan

ABSTRACT AND KEYWORDS

In Nigeria, tree crops are cultivated primarily for cash. Hence, increased cultivation is expected to enhance farm household livelihood outcomes through increased income from exports, reduced effect of climate and price shocks, increased capital accumulation from mature trees and more stable future income flows for farm households. To mitigate the effect of frequent global crude oil price shocks, the Federal Government of Nigeria adopted the Zero-Oil Plan (ZOP) in 2016 to facilitate the growth of non-oil exports. Under this policy, the federal and state governments encouraged hectarage expansion and increased productivity of commercial tree crops such as cocoa, cashew and oil palm given their high potentials to generate foreign exchange for the country. Using primary data collected from a sample of 545 small-scale farm households (SSFHs) and 519 medium-scale farm households (MSFHs) in Ogun State, Nigeria, this study investigates key factors that positively impact the land allocation decisions of households with regards to tree crop cultivation. Preliminary data analysis shows that SSFHs and MSFHs cultivated only 56 per cent and 62.6 per cent of the total farmland area under their control; implying the average farm household still has substantial amounts of land available for expansion if the production and marketing environments are enhanced by appropriate policies.

The study finds that farm households who have access to land markets, all-weather roads, agro-dealer services and better transportation services – as well as those who possess better land tenure security – are more likely to cultivate tree crop fields, allocate larger areas of land to tree crops and allocate a higher share of total farm holdings to tree crop enterprises. These effects were observed to be mostly stronger within MSFHs than within SSFHs. Furthermore, female and youth-headed households were found to be less likely to invest in commercial tree crop farming.

Finally, we observe that tree crop cultivation as a pathway to agricultural commercialisation seems to be more popular with MSFHs than SSFHs in the study area. The study concludes by highlighting the importance of tangible land markets, critical rural infrastructure, agro-services, improved land tenure security and increased youth and female engagement in efforts to promote economic diversification in Nigeria through commercial tree crop farming. Thus, 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 and thereby improve the export potentials of the state. Also, the finding that the effect of the various identified factors on farmland redistribution in favour of commercial tree crop production is generally stronger for medium-scale farms (MSFs) relative to small-scale farms (SSFs) implies that encouraging the growth of MSFs could increase farm sector responsiveness to policies directed at area expansion for commercial tree crop production. Encouraging the growth of MSFs is likely to better enhance the cultivation of commercial tree crops in the study area.

Keywords: Agricultural lands, commercial tree crops, land allocation decision, farm households.

1 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.

According to the Governor of the Central Bank of Nigeria, Godwin Emefiele, the economic recession of 2016/2017 in Nigeria was mainly due to the plunge in commodity prices and in particular crude oil, which provides over 60 per cent of government revenue and 90 per cent of its foreign exchange inflows. Thus, the shocks in the oil market were transmitted entirely to the economy via the foreign exchange markets as manufacturers and traders who required forex to purchase inputs and goods were faced with a depleting supply of foreign exchange available in the country. This economic recession thereby prompted demand to promote a pro-growth strategy to reduce the country's reliance on earnings from the sale of crude oil as well as its dependence on importing items that can be produced in Nigeria (Emefiole 2019).

In response to this 2016/2017 economic recession triggered by a crash in oil prices, the Nigerian Export Promotion Council developed the ZOP as a core component of the government's Economic Recovery and Growth Plan (ERGP).[1]

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[2] and could generate up to US$30 billion per year in foreign exchange from non-oil exports as opposed to the current earnings of US$5 billion. The ZOP is also projected to add an extra US$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.

In August 2016, a meeting jointly convened by the Minister of Industry, Trade and Investment, the Minister of Agriculture and Rural Development; and the Chairman of the Board of Directors of the African Export-Import Bank set a national goal for cocoa value chain development to double production from the 2016 production level of about 200,000 tonnes and to revive the cocoa processing subsector to utilise 50 per cent of the country's annual production within a period of five years. As of 2019, three of these five years have already passed and cocoa production is still below 250,000 tonnes with the nation grappling with the logistics of how to help the industry take off.

Sesame, cashew and cocoa were identified by the Federal Government's Committee on ZOP implementation as three of the greatest growth areas for agricultural exports, employment creation and poverty reduction. 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.

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. The study uses primary data collected from a sample of small and medium-scale farmers in Ogun State. We specifically explore 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 characteristics and if these differ between SSFHs and MSFHs.

The study investigates two key hypotheses. Firstly, that 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. Secondly, that 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. Investigating the factors that drive land allocation decisions could yield useful policy insights into how to boost tree crop cultivation and, by extension, agricultural commercialisation; an important pathway to livelihood improvements in rural Nigeria.

2 IMPORTANCE OF TREE CROPS ON NIGERIAN FARMS

Agricultural land in Nigeria refers to the share of land area that is under arable crops, permanent crops, or permanent pastures.[3] It excludes land under trees grown for wood or timber.[4] Land under permanent crops is land cultivated with tree crops that occupy the land for long periods and need not be replanted after each harvest. This includes land planted to cocoa, oil palm, cashew, citrus, rubber and kolanuts. This cropping system, which is known as perennial agriculture, occupies roughly 15 per cent of the total cultivated cropland in Nigeria. While these perennial cropping systems take several years to become established, once production has begun, the main body of work is maintenance and harvesting.

For Nigerian farm households, a perennial agriculture system based on the cultivation of tree/permanent crops offers five major advantages over the traditional arable/annual agriculture system based on the cultivation of crops such as cereals, roots/tubers, vegetables, legumes and sesame.

Firstly, tree crops such as cocoa, cashew, oil palm and rubber play an important role in rural livelihoods; not only as a source of income (Degrande *et al.,* 2006; Kalaba *et al.,* 2010; Mbow *et al.,* 2014), but as a major source of foreign exchange earnings in Nigeria. For example, as shown in Table 1, cocoa and cashew (both tree/permanent crops) are the second and third most valuable agricultural exports from Nigeria after sesame (an arable/annual crop). In the first half of 2019, both crops contributed ₦90 billion out of the total ₦152 billion earned from the top ten agricultural exports in Nigeria[5] (over 53 per cent). Global demand for cocoa is projected to be 4.5 million tonnes in 2020 (Federal Ministry of Agriculture and Rural Development (FMARD), 2016) and to reach 6 million tonnes by 2025. However, production by Nigeria – the fourth largest producer globally – is below 0.25 million tonnes as of 2019. The total supply by all major producers combined is less than 50 per cent of the projected demand for 2025. Consequently, increasing hectarage under cocoa production by farm households in Nigeria could potentially contribute to substantial increases in household income and poverty reduction.

Secondly, tree crop cultivation could contribute to improving livelihood outcomes among farm households by enabling farmers to provide resources for seasonal gap filling. Anecdotal evidence shows that tree crops tend to provide a buffer in between agricultural harvests and during times of unforeseen hardship. Thirdly, allocating more land to commercial tree crop production can provide a useful method of saving. Tree crops require smaller capital investment compared to other methods of savings such as livestock. Farmers could build up a stock of capital in the form of mature trees that can be harvested and sold for cash in times of emergency. Under favourable growing conditions, their value appreciates, and they are not too susceptible to inflation.

Fourthly, commercial tree crops have been found to provide a measure of insurance. Anecdotal evidence

Table 2.1: Share of total export value from top ten agricultural exports in first half of 2019 in Nigeria

Product group	Specific components in order of importance	Export value in million (₦)	Share of total export value from top ten agricultural exports (%)
Sesame and Products	Sesame seeds; sesame oil and its fractions	61,619.55	40.44
Cocoa and products	Fermented cocoa beans; quality raw cocoa beans; and natural cocoa butter	50,459.14	33.12
Cashew nuts	Cashew nuts (in shell); cashew nuts (shelled)	30,645.24	20.11
Others	Frozen shrimps and prawns; ginger; and agro food items.	9,644.78	6.33
Total		**152,368.61**	**100**

Source: Authors' own (based on Adesoji 2019) suggests that tree crop output response to shocks tends to be lower than arable crops and so provides safety nets during shocks for asset-poor farm households (Wunder *et al*. 2014). Fifthly, tree crops perform important ecological functions, including the provision of soil nutrients and habitat for animals, prevention of soil erosion, creation of shelter belts and wind breaks for the desertification control efforts of the Federal Government of Nigeria (Manning *et al*. 2006; Place and Garrity 2015). They serve as a key basis for biodiversity conservation (Bhagwat *et al*. 2008; Schroth *et al*. 2013) and climate change adaptation and mitigation (Mbow *et al*. 2014). Tree crops also help to maintain the productivity of land by substituting, to some extent, for purchased fertiliser and herbicide inputs and investments in soil.

3 THEORETICAL FRAMEWORK AND LITERATURE REVIEW

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 (Sunding and Zilberman 2001; 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.

The 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 (Ndhlovu 2010; Hettig *et al.* 2016, Mwaura and Adong 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. In such cases, decisions on land allocation would depend on the household's own shadow price for family labour, leisure and assets and would not be determined by external factor market prices. Furthermore, land use decisions are determined by the respective agricultural technology available to be adopted by households. Finally, land use decisions can be induced by neighborhood spillover effects, such as copying or knowledge transfer across informal networks.

In some developing countries, there appears to be a shift by farmers from the cultivation of less profitable to more profitable crops (Vyas 1996). Higher valued crops usually include horticulture, spices, oilseeds, tree crops and other cash crops. The emergence of crop diversification is an indication that two things are happening. Firstly, there is change in the business environment where farmers are responding to arising opportunities such as new production technologies and price signals in the market. Secondly, there is a more efficient allocation of resources.

In the empirical literature available, 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 and 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. Nkonya *et al.* (2005) broadly categorised these factors into (i) physical capital (farm size, livestock and other household's assets); (ii) human capital (comprising sex, age and education of the head of household and household labour); (iii) financial capital (including a farm household's liquid financial asset and access to credit). Depending on the extent to which markets are imperfect or missing, household level factors affect the household's ability to finance crop production decisions such as purchasing of inputs and hiring of additional labour.

Pattanayak *et al.* (2003) classified explanatory variables that influence household land allocation choice for agro-forestry into five broad categories. These include household preferences, resource endowments, market incentives, risk and uncertainty and biophysical characteristics. Household preferences include variables that measure household specific characteristics such as risk tolerance, innovativeness and household homogeneity.

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. Coxhead and Demeke (2004) used the tobit model to estimate cropland allocation decisions for upland agricultural households in Philippines using panel data. The study reported total farm area, expected revenue of various crops (own and cross), wage rate, slope, distance to the road, available farm labour force and the age of household head to have significantly affected land allocations to various crops. Mponela *et al.* (2011) used the tobit regression model on cross-sectional data to analyse factors that influence households' land allocation decisions to jatropha curcas. Their results indicate that age, education of household head, availability of labour and ownership of uncultivated land all exert significant and positive influences on land allocation to jatropha curcas, whereas ownership of livestock and non-farm income deterred households from cultivating the crop.

Sikor and Baggio (2014) employed the Heckman regression model to examine the possibility smallholders engage in plantations as a potential means for poverty alleviation in rural Vietnam. They found that better-off households are more likely to possess forestland, grow trees and invest in plantations than poor ones. In addition, land, plantations, and investment tend to be larger for the better-off than the poor. They conclude that better-off households are in a better position to engage in tree plantations due to the institutional mechanisms differentiating household access to land and finance. Kulindwa (2016) used the Heckman model to analyse the factors that drive tree planting behaviour in Tanzania. Findings show that households' land sizes, households' awareness of tree planting programmes, tree planting for wood energy, and the age of the head of the household were the significant factors influencing farmers' tree planting behaviour in the study area.

Nigussie *et al.* (2017) used the tobit regression model to investigate factors affecting SSFs' land allocation and tree density decisions in an acacia decurrens-based taungya system in Ethiopia. They found that the most important motivations for planting acacia decurrens were income, soil fertility management, and soil and water conservation. Having a male head of household, long distance to markets and plots being on marginal land – among other factors – also increase the allocation of land to acacia decurrens woodlots. Having a male head of household, access to credit and plots being on marginal land – among other factors – increased tree planting density. Age had a negative effect on both allocation of land to woodlots and tree density, whereas farm size had an inverted U-shaped relationship with both decisions. On the other hand, Dashti *et al.* (2017) employed both the tobit and Heckman regression models to analyse factors affecting the decisions of farmers in Iran to plant canola crop and how much of it to plant. Tobit results showed that real price, farm income, amount of credit and education had a positive and significant effect on the area under canola cultivation, while machinery costs per hectare had a negative effect. The results of estimated probit model in the first stage of the Heckman approach showed that machinery ownership had an important effect on canola adoption, as a 1 per cent increase in machinery ownership led to a 0.158 per cent increase in canola adoption probability. Contact with extension agents, farm income proportion, education, and farmers' experience increased the probability of owning canola plantation, while age and the number of fragmentations had a negative impact on it. The second step of Heckman's estimation results indicated loan amount, canola relative benefit, and family labour had a positive effect on canola acreage, while machinery cost and farm distance from the road had a negative effect.

Embaye *et al*. (2018) used the Heckman model to determine factors that influenced farmers' willingness to adopt and allocate land for growing non-food oilseeds as bio-energy crops across the west of the USA. Their findings show that factors such as farm income and gender positively affected land allocation decisions, whereas percentage of land rented on a crop share basis, profit ratio (wheat/canola) and livestock ownership exerted negative influence. Similarly, Mizab and Falsafian (2017) examined factors influencing the decisions on saffron cultivation and its expansion using the Heckman model and found that while age, familiarity with saffron growing, attending saffron training courses, the number of extension courses, marketing status, and the profit status of saffron all had positive effects on the decision to grow saffron, farmer's education level, total area under agricultural and horticultural cultivation as well as features of agricultural land also had positive effects on the area cultivated to saffron.

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?

4 STUDY AREA, DATA AND VARIABLES DESCRIPTION

4.1 Study area

Ogun State is one of the 36 states that make up the federal republic of Nigeria and occupies a land area of 16,762km². It is one of the six states that constitutes the South Western Geopolitical Zone of Nigeria. Abeokuta – the capital city of Ogun State – is about 90km from Lagos and 740km from the capital of Nigeria, Abuja. The state is strategically located. It is bordered in the west by the Republic of Benin, which makes it an access route to the expansive markets of the Economic Community of West African States (ECOWAS). The state's total projected population is 7.1 million and it has one of the highest concentration of industries in Nigeria. Known as 'The Gateway State', it totally engulfs Lagos State and serves as the major link between the nation's commercial centre Lagos and the rest of Nigeria. It also serves as a major link to the West African markets. Ogun State is located in the rainforest part of Nigeria, where the vegetation is highly suited for the growth of commercial tree crops.

The decision to choose Ogun State for this study was made for the following reasons: Firstly, over the past two decades, Ogun State has made giant strides in providing the necessary policy environment for the development of commercial agriculture. For example, Ogun State was one of the 14 states that provided land for the establishment of production clusters under the Federal Government Agricultural Transformation Agenda (2011-2015).[6] Major crops cultivated in the state include maize, cassava, cocoa, yam/cocoyam, oil palm, cashew, plantain, banana, citrus, mango, water-melon, vegetables, ginger, garlic and pepper.

Secondly, to demonstrate the important position tree crop production occupies in the economy of the state, in 2008 the State Ministry of Agriculture created a Department of Tree Crops and Rural Development Services, which is mandated to position Ogun State as the number one producer of tree crops in Nigeria, to position the tree crops sector for carbon sequestration in this era of climate change, to facilitate livelihood enhancement for tree crop farmers in the state and to encourage youth engagement in tree crop farming.

Thirdly, Table 2 shows that 36 per cent of land cultivated to crops by over 1,000 randomly sampled farmers in this study is devoted to tree crops and the remaining 64 per cent to arable crops. This underscores the importance of tree crops in the cropping system of the state. Furthermore, cocoa and cashew – currently the second and third most valuable agricultural export crops in Nigeria[7] – together account for about 81 per cent of land area allocated to tree crops in the state. More specifically, 70 per cent of the area allocated to tree crops is under cocoa, while 11 per cent is under cashew. Consequently, the policy implications of this study would be relevant to other tree crop producing states in Nigeria; especially those within south-western Nigeria that have climatic, socio-economic, and cultural characteristics similar to Ogun State.

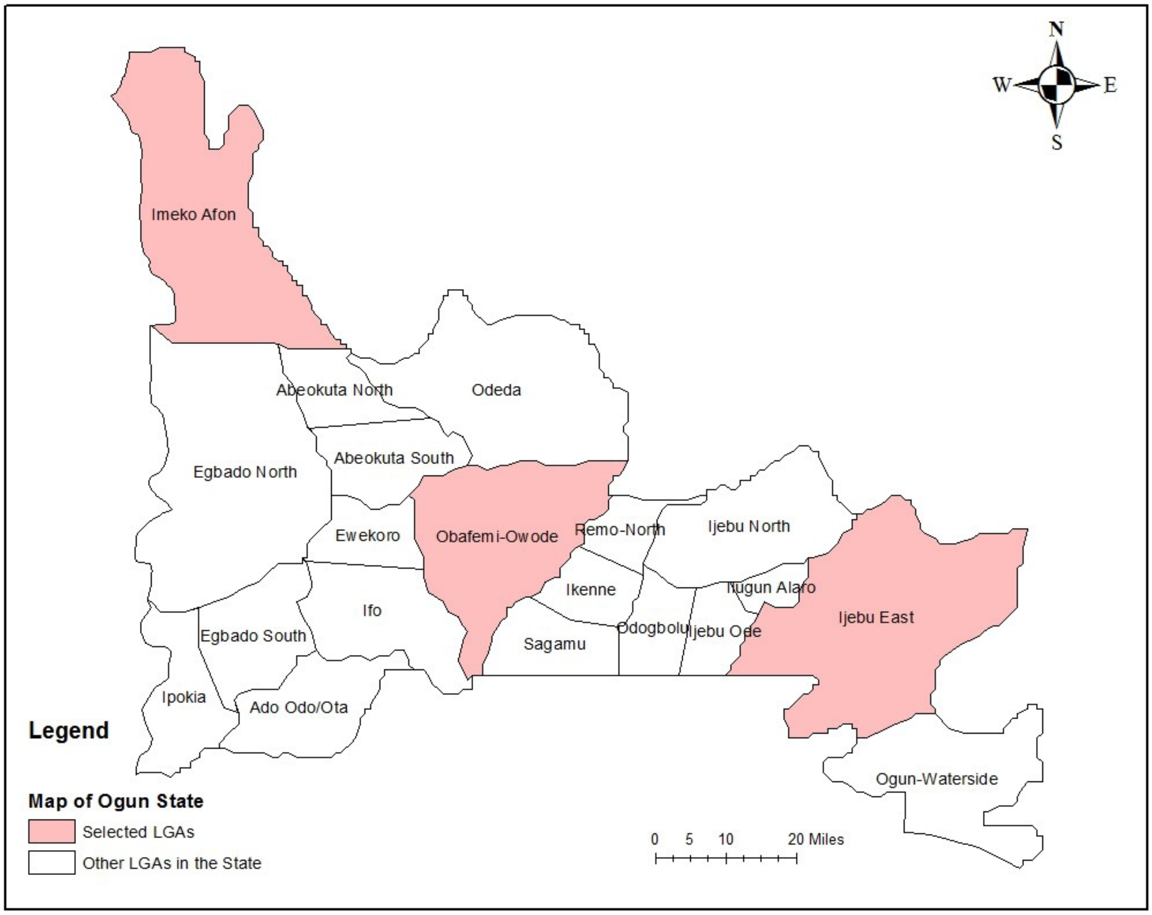
4.2 Sampling design[8]

A multi-stage sampling procedure combining purposive, cluster and proportionate random sampling techniques was utilised to select a sample of 519 MSFHs and 545 SSFHs. In the first stage, Ogun State was purposively selected based on reasons provided above. 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 each LGA in Ogun State were selected using a combination of cluster and random sampling. Proportionate random sampling was then used to select 519 MSFs and 545 SSFs across Ogun State, respectively. Data collection was cross-sectional in nature and was carried out with the aid of a structured electronic questionnaire. In this study, SSFs are classed as those that operate less than 5ha, while MSFs operate between 5-100ha (Jayne and Muyanga 2018; Muyanga *et al.,* 2019).

4.3 Description of model variables

The summary of key variables used in this study is found in Appendix 1. The descriptive statistics are presented in Appendix 2 (pooled farm households), Appendix 3 (SSFHs), and Appendix 4 (MSFHs).
The data shows that that only 25.7 per cent of SSFHs and 57.37 per cent of MSFHs own tree crop

Figure 4.1: Map of Ogun State, Nigeria, showing APRA study LGAs



Source: Authors' own

plantations. The average farm size is 2.28ha for SSFHs and 11.4ha for MSFHs. The share of tree crops in total cropped land is 16 per cent for SSFHs compared with 36.7 per cent for MSFHs. Furthermore, among tree crop farmers alone, land area under tree crops averages 2.79ha for SSFHs and 12.23ha 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 land area under the control of the average SSFH is 4.05ha compared with 18.02ha for MSFHs. Thus, SSFHs are currently cultivating about 56 per cent of the land under their control compared with 62.6 per cent for MSFHs. This implies that the average farm household still has a substantial amount of land for expansion if production and marketing environment is enhanced by appropriate policy.

The data also shows that 23.6 per cent of all farm households in the study are natives, while 16.5 per cent of SSFHs and 31 per cent of MSFHs are natives. Land ownership is about 76.3 per cent, while land title ownership is only 3.0 per cent among farm households in the study area. Furthermore, land ownership is about 74 per cent and 79 per cent among SSFHs and MSFHs respectively, while land title ownership is 0.7 per cent and 5.7 per cent among SSFHs and MSFHs respectively. This implies exceptionally low security of tenure among farmers; especially SSFs. We observe that access to machinery services by farm households in the study area is also very low and stands at 6.2 per cent. However, access is higher among MSFHs (10 per cent) relative to SSFHs (3 per cent). Access to fertiliser by farm households in the study area is also low at 24 per cent but this is substantially higher among MSFHs (36 per cent) relative to SSFHs (14 per cent). Access to extension services by farm households is very low at about 13 per cent, but higher for MSFHs (19 per cent) relative to SSFHs (7 per cent). Access of farm households to agro-service dealers and established markets is low at 26 per cent and 47 per cent respectively and do not differ substantially between MSFHs and SSFHs. In addition, only 13.3 per cent 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.

5 EMPIRICAL STRATEGY

5.1 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) and Platinga (2006), which has been used by a number of economists in dealing with estimations of factors influencing share of land allocated to various uses (Wu and Brorsen 1995; Wu and Segerson 1995; Mu and McCarl 2011). The expected share of any crop is 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 regards 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:

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

$$\mathrm{Y_i} = Y_i^* \text{ if } Y_i^* > 0, \qquad (2)$$

$$\mathrm{Yi} = 0 \text{ if } Y_i^* \le 0, \qquad (3)$$

$$\mathrm{Y_i} = X_{ij}\beta_j + \varepsilon_{i\,,} \qquad (4)$$

$$i = 1,2,3\ldots\ldots.n,$$
$$k = 1,2\ldots\ldots\ldots.m$$

Note that Y_i is observable and 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 is an independently distributed error term or unobservable variable that affects and is assumed to be normally distributed with a zero mean and constant variance. The hypothesised explanatory variables, X_j, are as follows. Household head characteristics are: age (years), sex (male = 1, other = 0), marital status (married = 1, otherwise = 0), nativity (community native = 1, otherwise = 0) and dependency ratio (sum of number of children under 15 years old and the older population aged 65+ divided by the working-age population aged 15-64 years). Input market access characteristics are: access to machinery (have access = 1, otherwise = 0), fertiliser (have access = 1, otherwise = 0), land market (have access = 1, otherwise = 0), agro-dealers (have access = 1, otherwise = 0), hired labour (have access = 1, otherwise = 0)], access to product market (have access = 1, otherwise = 0), access to all-weather roads (have access = 1, otherwise = 0) and access to traders with large carriage capacity (have access = 1, otherwise = 0). Knowledge and information access characteristics are: house head education (no formal education = 1, otherwise = 0), years of farming experience (years) and extension services (visited by extension agents during last year = 1, otherwise = 0). Farm household wealth status characteristics are: livestock ownership (measured as tropical livestock unit), off-farm income (₦), value of farm assets (₦) , value of home assets (₦), land area cultivated (ha)], land tenure security and land ownership status (if owner of the land = 0, otherwise = 0) and land title ownership (if having title on the land = 1, otherwise = 0).

5.2 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 permanent crop.

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:

$$\mathrm{Y_i} = X_{ij}\beta_j + \varepsilon_{i\,.} \qquad (5)$$

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:

$$A_i = \alpha_0 + \alpha_j X_{ij} + IMR_{ij}. \qquad (6)$$

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.

6 RESULTS AND DISCUSSION

6.1 Commercialisation indices of crops and crop groupings in the study area

The analysis in this paper classifies crops as belonging to one of two broad categories; namely tree crops and arable crops. Tree crops include cashew, citrus, orange, guava, cocoa, coconut, oil palm and kolanut (Table 5). These are also known as permanent crops. The arable crops group consists of five annual crop groupings; namely cereal (maize, sorghum, rice, millet), legumes (cowpea, beans, groundnut, soya beans), starch/sugars (yam, sugarcane, cocoyam, potato, sweet potato, cassava, plantain), arable fruits/nuts (water melon, banana, ginger, pineapple, bambara), and horticulture (okra, onion garden egg, spinach, leafy vegetable, cabbage, cucumber, tomato, zobo, melon, pepper/chili, ginger, onion).

Table 5 shows that tree crops account for as much as 36 per cent of total farmland cultivated by all farmers, while arable crops account for 64 per cent in Ogun State. Thus, commercial tree crops are an important feature of the farming system in Ogun State and that provides justification for using data from the state for this study.

Table 2 also shows that in Ogun State, the crop commercialisation index (CCI) is only slightly higher for the tree crops (0.97) compared with arable/annual crops (0.94). Thus, crop farming in Ogun State is highly commercialised but when compared with arable crops, tree crop farming seems to be more rewarding because of the higher international export potential. Furthermore, we observe that tree crop cultivation is more predominant among MSFs, compared with SSFs. Specifically, Table 2 shows that MSFs in Ogun State cultivate 40 per cent of their farmland to tree crops and 60 per cent to arable crops, while SSFs cultivate only 19 per cent of land to tree crops and 81 per cent to arable crops. Thus, arable crops are more important than tree crops in the cropping patterns of both SSFs and MSFs. However, tree crop cultivation is more important with MSFs relative to SSFs when CCIs are considered. We also observe from the table that the CCI does not vary much between SSFs and MSFs.

Table 3 shows that cocoa is the most predominant tree crop in Ogun State in accounting for around 70 per cent of the total land allocated to tree crops. This is followed by kolanut and cashew, which account for 12 per cent and 11 per cent of total land under tree crops respectively. The table further shows that tree crop enterprises are highly commercialised enterprises as seen by the high levels of CCI, which range from 0.86 to 1.00 for all tree/permanent crops planted in the study area. The average CCI for tree crops is about 98 per cent. In other words, these tree crops are produced primarily for sale and can therefore be referred to as cash crops, market-oriented crops or commercial crops. In this study, the crop is regarded as a cash, commercial or market-oriented crop if the CCI of that crop is above 75 per cent. According to Goletti (2005) and Ohen *et al.* (2013), farmers (small or large) are said to be commercial if they sell more than 75 per cent of their total production.

It is important to note, however, that unlike other permanent/tree crops, oil palm is not a commercial/

Table 6.1: Share of land area cultivated and CCI of tree crops (permanent crops) and arable (annual) crops by scale of farm in Ogun State

	MSFs N = 2217			**SSFs N = 1345**			**Pooled N = 3562**		
Crop grouping	**Land area cultivated**	**Share of total**	**CCI**	**Land area cultivated**	**Share of total**	**CCI**	**Land area cultivated**	**Share of total**	**CCI**
Tree crops	2168.22	0.40	0.97	250.69	0.19	0.98	2418.91	0.36	0.97
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: CCI is computed as percentage of total output produced by household that is sold

Source: APRA Nigeria Field Survey, April/May 2018

Table 6.2: Share of land area cultivated and CCI for tree crops (permanent crops) by scale of farm in Ogun State

	MSFs N = 904			SSFs N = 216			Pooled N = 1120		
Tree Crop Grouping	**Land area cultivated**	**Share of total Tree crop**	**CCI**	**Land Area cultivated**	**Share of total tree crop**	**CCI**	**Land Area cultivated**	**Share of total tree crop**	**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 crop total	2168.22	1.000	0.9745	250.69	1.000	0.9826	2418.91	1.000	0.9753

Note: CCI is computed as percentage of total output produced by household that is sold

Source: APRA Nigeria Field Survey, April/May 2018

Table 6.3: Share of land area cultivated and CCI for arable crops (Ogun State)

	MSFs N = 1313			SSFs N = 1129			Pooled N = 2442		
Crop grouping	**Land area cultivated**	**Share of total land**	**CCI**	**Land area cultivated**	**Share of total land**	**CCI**	**Land area cultivated**	**Share of total land**	**CCI**
Cereals	773.332	0.243	0.9579	282.747	0.267	0.9182	1056.079	0.249	0.9488
Legumes	144.82	0.045	0.9612	16.1	0.015	0.9317	160.92	0.038	0.9579
Starch/ Sugars	1922.311	0.603	0.9419	666.168	0.629	0.9299	2588.479	0.609	0.938
Arable fruits/ nuts	74.225	0.023	0.5354	1.812	0.002	0.9896	76.037	0.018	0.5529
Horticulture	272.736	0.086	0.9468	92.693	0.087	0.9544	365.429	0.086	0.9488
All arable crops total	3187.424	1.000	0.942	1059.52	1.000	0.9299	4246.944	1.000	0.9382

Note: CCI is computed as percentage of total output produced by household that is sold.

cash crop for SSFs in the study area. The implication of this is that SSFs primarily live off their oil palm plantations for palm oil which they consume with only some parts going to the market, while MSFs produce oil palm mostly for the market.

With respect to arable crops, Table 4 shows that the starch/sugar crop group is the most predominant arable crop group in the state with about 61 per cent share of land under arable crops. This is followed by cereals, which account for about 25 per cent share of total land planted to arable crops. Interestingly, the table also shows that in Ogun State, most arable crops are primarily grown as cash/commercial crops by both the MSFs and SSFs. The CCI is above 0.91 for all crop groups except arable fruits/nuts under MSFs, which is classified as non-commercial/food crop because of the low CCI of under 54 per cent; significantly less than the threshold of 75 per cent needed for it to considered a commercial crop.

6.2 Determinants of share of farmland allocated to tree crops

We estimate a tobit regression equation to identify factors that influence the share of total operated farmland farm households in the study area allocated to tree/permanent crops. In other words, we investigate factors that guide the behaviour of farm households as they distribute their operated land between tree crops and arable crops cultivation. Crops categorised under tree crops are cashew, citrus, orange, guava, cocoa, coconut, oil palm and kolanut. The alternate group is arable crops, which includes maize, sorghum, rice,

Table 6.4: Factors influencing share of land allocated to tree/permanent crops

Share of tree crops	Total sample	P>|z|	Marginal effect	Small-scale	P>|z|	Marginal effect	Medium-scale	P>|z|	Marginal effect
Education (in years)	0.0007 (0.0055)	0.900	0.0003	-0.0203* (0.0123)	0.099	-0.0050	0.0054 (0.0052)	0.297	0.0034
Access to land market	0.3163*** (0.0535)	0.000	0.1334	-0.0390 (0.1296)	0.764	0.0097	0.1971*** (0.0517)	0.000	0.1216
Access to hired labour	-0.1734** (0.0750)	0.021	-0.0731	-0.0962 (0.1361)	0.480	-0.0240	-0.1322 (0.0828)	0.111	-0.0816
Off-farm income	-0.00007 (0.00005)	0.138	-0.00003	-0.00003 (0.0002)	0.882	-6.34E-09	-0.00004 (0.00004)	0.373	-0.00002
Land ownership	0.5540*** (0.0684)	0.000	0.2336	0.3805*** (0.1337)	0.005	0.0947	0.4718*** (0.0697)	0.000	0.2912
Land area under control	-6.5E-06 (0.00001)	0.587	-2.73E-06	0.0010** (0.0005)	0.023	0.0003	-0.00002 (0.0004)	0.970	-0.00001
Value of farm assets	0.0011** (0.0004)	0.013	0.0005	0.0169*** (0.0045)	0.000	0.0004	0.0005 (0.0003)	0.126	0.0003
Value of home assets	-0.00004 (0.00006)	0.476	-0.00002	-0.0005 (0.0003)	0.134	-0.00001	-0.00009* (0.00006)	0.088	-0.0001
Access to extension service	0.0436 (0.0775)	0.574	0.0184	-0.0343 (0.1964)	0.862	-0.0085	-0.0004 (0.0689)	0.996	-0.0002
Access to agro-dealer	0.0643 (0.0561)	0.251	0.0271	0.0215 (0.1144)	0.851	0.0054	0.1040* (0.0572)	0.070	0.0642
Access to all-weather road	0.1566** (0.0790)	0.048	0.0660	0.2600 (0.1615)	0.108	0.0647	0.1031 (0.0817)	0.208	0.0636
Sex (male = 1)	0.3690*** (0.1190)	0.002	0.1556	0.4612** (0.2292)	0.045	0.1148	0.3344** (0.1317)	0.011	0.2064
Access to large haulage vehicles	0.0750 (0.0499)	0.134	0.0316	0.1815* (0.0971)	0.062	0.0452	0.0521 (0.0510)	0.307	0.0321
Access to fertiliser (access to fertiliser = 1)	-0.2515*** (0.0650)	0.000	-0.1061	-0.2174 (0.1536)	0.157	-0.0541	-0.3643*** (0.0593)	0.000	-0.2248
Access to machinery (access to machinery = 1)	-0.4096*** (0.1246)	0.001	-0.1727	-0.5656 (0.3903)	0.148	-0.1408	-0.4124*** (0.1054)	0.000	-0.2545
Youth (youth = 1)	-0.1863** (0.0806)	0.021	-0.0786	-0.0322 (0.1382)	0.816	-0.0080	-0.2237** (0.0933)	0.017	-0.1381
Constant	-1.0724*** (0.1580)	0.000		-1.5214*** (0.3150)	0.000		-0.5604*** (0.1711)	0.001	
Sigma	0.6779 (0.0266)			0.8546 (0.0597)			0.5000 (0.0231)		
Log Likelihood	-802.739			-358.839			-350.156		
Number of obs	1,060			586			492		
LR Chi^2 (16)	157.53			52.4			158.91		
Prob > Chi^2	0.0000			0.0000			0.0000		
Pseudo R^2	0.0894			0.0680			0.1849		

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

millet, cowpea, beans, yam, sugarcane, cocoyam, sweet potato, cassava, plantain, banana, ginger, pineapple, water melon, okra, garden egg, spinach, cabbage, cucumber, potato, tomato, zobo, pepper, onion, groundnut and bambara nut (Table 4).

Table 5 presents the results of the tobit regression model for factors influencing land share to tree crop in the study area. Although the Pseudo R^2 for the model is quite low (between 9 per cent and 18 per cent), the level of the explanatory power is consistent with other studies that used cross-sectional and censored data and Tobin (1958), who argued that the Pseudo R^2 or McFadden's R^2 should not be taken as the best measure of model fit. The significant likelihood ratio at 1 per cent level revealed joint significance of the independent variables in explaining the disturbance of the error terms in the model. The results also include the marginal effect of the explanatory variables.

Results presented in Table 5 show that the household head's gender, access to land market, land ownership and access to all-weather roads are the four most important factors that positively influence the share of farmland allocated to tree crops in the study area. For example, having a male as head of the household increases the expected land allocation to tree crops by about 0.12 and 0.21 percentage points respectively for SSFHs and MSFHs since the coefficient signs are positive. This agrees with the findings of Embaye *et al.* (2018). The results also show that MSFHs with access to land market are likely to allocate 12 per cent more land to those without access to land market. Thus, a better functioning land market that ensures easier access to land could help increase the relative importance of commercial tree crops in the crop mix of farmers in Ogun State. This factor was, however, not significant among SSFHs. For SSFHs, the limitations associated with traditional barriers to land access may be at play. We find that the share of farmland cultivated to tree crops is likely to be 29 per cent higher for MSFHs that own land relative to those who do not own land. The fact land ownership has such a major effect is no surprise considering the long planning horizon associated with tree crops. This effect is stronger for MSFHs than SSFHs. This correlates with other studies (such as Zhang and Owiredu 2007; Ayele 2009; Jenbere *et al.* 2012; Oeba *et al.* 2012; Ndayambaje *et al.* 2013; Abiyu *et al.* 2015; Nyaga *et al.,* 2015; Kulindwa 2016; Gizachew 2017; Derbe *et al.* 2018) that have shown that land ownership is a significant factor influencing the share of land farm households are allocating to tree crop cultivation. Hence, policies that enhance farmland ownership among farm households could facilitate the redistribution of land in favour of commercial tree crops relative to arable crops in the crop mix of farm households in Ogun State, thereby enhancing their export capabilities. Furthermore, farm households (irrespective of scale of operation) who have access to all-weather roads are likely to allocate 7 per cent more land to tree crops compared to those without access. Access to good roads is obviously an enabling factor for the allocation of land toward exportable crops.

Moreover, Table 5 also reveals that access to fertiliser, access to machinery services and youthfulness of household head are the three most important variables that negatively affect the share of farmland allocated to tree crops among MSFHs. This is an indication that MSFHs who have access to these external inputs are more likely to commit a larger share of their farmland to short duration arable/annual commercial crops relative to longer duration commercial permanent/tree crops. Indeed, fertiliser and machinery are more critical to the production of annual crops. This might be due to the need to recover production costs quicker for the repayment of short-term credit facilities. However, this might also suggest that young farmers and those that have better access to fertiliser and machinery actually prefer annual crops while those with strong assets, land endowment and stronger infrastructure prefer more perennial crops. The implication is that input policies focusing on increased access to fertiliser and machinery services are unlikely to be effective in motivating farm households to increase the share of farmland allocated to commercial permanent/tree crops if other things such as long-term credit facilities and access to land market are not addressed. Interestingly, these three factors do not exert significant influence on tree crop share of farmland among SSFHs.

The results of the tobit model further shows that farm households headed by youths are likely to allocate 14 per cent less of their farmland to commercial tree crops relative to households headed by non-youths.

6.3 Determinants of size of farmland under commercial tree crops

In order to further investigate the determinants of allocation to tree crops vis-a-vis arable crops in Ogun State, we estimate a two-stage Heckman selection model to investigate factors that influence the size of farmland put under tree crop cultivation. Assuming that the area cultivated to tree crops follows a two-stage decision process which includes a decision to either allocate or not allocate land to permanent crops followed by a decision on the size of land to be allocated to them, we adopt Heckman's selection regression to model the decision to increase or decrease land area under tree crops. For the Heckman regression model, the dependent variable for the selection model (equation) is the choice of a farmer to cultivate permanent crops or not (if farmer cultivates = 1 and otherwise = 0); while the dependent variable for the outcome model (equation) is the size (ha) of land allocated to permanent crops. The outcome model is only relevant for those who are selected in the selection model. The result of the selection equation is presented in Table 6, while that of the outcome equation is presented in Table 7.

6.3.1 Determinants of the decision to allocate land to tree crops

In the probit results presented in Table 6, the significance of the likelihood ratio (LR) test at 1 per cent level implies that the estimated correlation between the errors is significantly different from zero and the hypothesis of absence of sample selection is strongly rejected. The overall significance level of Heckman selection (probit) at 1 per cent 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 per cent 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 (Table 10). This result is consistent with the principle of exclusion restrictions when estimating the Heckman model (Sartori 2003; Kennedy 2006; 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 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 (Table 6). 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 per cent and 30 per cent 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. The finding that male farmers are more likely to allocate farmland to permanent crops compared with female farmers implies that women are more likely to own arable crop farms 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 per cent and 13 per cent respectively. This result is consistent with Gebreegziabher *et al.* (2010), who revealed that ownership of land size has a significant and positive effect on tree planting decisions and production. 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. This result also lines up with the finding under the tobit model reported in Table 8 that land ownership status is an important determinant of the share of farmland allocated to tree crops vis-a-vis arable crops. Thus, policies directed at increasing security of tenure among farm households could positively impact land allocation to tree crops – especially among MSFHs.

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 per cent more likely to allocate farmland to commercial tree crops. This effect does not, however, extend to the actual land area cultivated to tree crops; as shown in Table 10. The implication is that cultivation of tree crops can be enhanced among SSFHs if there is improvement in farmers' access to all-weather roads.

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 compared with arable crops. In Table 6, the likelihood that MSFHs will allocate land to commercial tree crops declines by 32 per cent with access to fertiliser and by 29 per cent with access to machinery services. By implication, MSFHs with access to fertiliser and machinery services are more likely to allocate land to arable crop cultivation. 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 (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.

6.3.2: Determinants of actual area of land allocated to tree crops

Table 7 shows that 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 access to hired labour.

More specifically, we find that farm households (irrespective of scale of operation) who have access to land market will put about 0.17ha more land under tree

Table 6.5: 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 to machinery = 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: APRA Nigeria Field Survey, April/May 2018

crops than those without access to land market. The result shows that increased access to land through better functioning land markets 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. Thus, improvements in land rental markets could enhance agricultural commercialisation not only among MSFs but also among SSFs through increased cultivation of tree crops.

The coefficient of education is positive and significant for both MSFs and SSFs. This shows that more highly educated household heads tend to allocate larger areas of farmland to commercial tree crops. This is in

Table 6.6: 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 owner-ship	-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		

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

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 SSFs.

The coefficient of access to agro-service dealers by the MSFHs is positive and significant at 1 per cent 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 7). Thus, policies that increase access to agro-dealer services could lead to expansion in land under commercial tree crops cultivation; especially among MSFHs. The coefficient of off-farm income is negative and significant at 5 per cent level with MSFHs. This implies that MSFHs with higher off-farm income allocate less land to tree crops. Thus, higher income inflow to a household from off-farm sources reduces the importance of tree crops in the crop mix. 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) and Deressa *et al.* (2009), 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 per cent and 1 per cent 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. This is in contrast with the observations of Mizab and Falsafian (2017), who found a positive effect of extension activities on decisions to allocate land to saffron in Iran.

7 CONCLUSION AND POLICY IMPLICATIONS

7.1 Key findings

Tree crops are cultivated primarily for cash in Ogun State and generally in Nigeria. Increased cultivation of commercial tree crops is expected to reduce rural poverty through increased income from exports, reduced effect of climate and price shocks on farm household welfare, and increased capital accumulation in the form of mature trees and stability of income flow to farm households over a longer term. In the face of frequent global crude oil price shocks, the Federal Government of Nigeria launched the ZOP in 2016 to facilitate the growth expansion of non-oil exports in Nigeria. Cocoa, cashew and oil palm were three of the 11 agricultural products identified as having high potentials to generate foreign exchange for the country.

To promote evidence-based policy formulation and implementation, it is important to systematically understand the policy related factors that could positively influence the expansion of area cultivated under these crops. This study utilises primary data collected from a sample of 545 SSFHs and 519 MSFHs in Ogun State to investigate the land allocation behaviour of farm households with regards to tree crop cultivation. More specifically, the paper tests hypotheses on the effects of factors such as market access, human capital, knowledge acquisition and dissemination, land ownership and tenure security, household head characteristics and ownership and size of land cultivated.

The study finds that:

i. All tree crops in the study area; namely cashew, citrus, orange, guava, cocoa, coconut, oil palm and kolanut were categorised as commercial or cash crops in the study area given the computed crop commercialisation indices of above 75 per cent. Commercial tree crop cultivation was found to be more important to MSFHs than SSFHs. Specifically, MSFHs and SSFHs cultivate 40 per cent and 19 per cent of their farmlands to commercial tree crops respectively.

ii. Commercial tree/permanent crops account for 40 per cent of total land area under crop farming in the study area, while arable crop accounts for 60 per cent.

iii. Cocoa accounts for 69 per cent of land planted to tree crops in the study area, while cashew and oil palm account for 11 per cent and 6 per cent respectively.

iv. 25.7 per cent of SSFHs compared with 57.37 per cent of MSFHs own tree crops plantations.

v. Average farm size is 2.28 ha for SSFHs compared to 11.4 ha for MSFHs and this amounts to 56 per cent of the total farmland area under the control of SSFHs compared to 62.6 per cent for MSFHs. This implies that the average farm household still has a substantial amount of land for expansion if production and marketing environment is enhanced by appropriate policies.

vi. The share of tree crops in total cropped land is 16 per cent for SSFHs compared to 36.7 per cent for MSFHs.

vii. Among tree crop farmers alone, land area under tree crops plantation averages 2.79 ha for SSFHs and 12.23 ha for MSFHs.

viii. First stage Heckman model reveals that male-headed farm households are 20 per cent and 30 per cent more likely to own tree crop plantations for SSFHs and MSFHs respectively, compared to female headed households. Furthermore, results from the tobit model suggest that male-headed farm households are likely to allocate 12 percent more land to tree crops if SSFHs and 21 per cent more likely to allocate land to tree crops if MSFHs when compared to female-headed households.

ix. The tobit model shows that MSFHs with access to land market are likely to allocate 12 per cent more land to tree crops than those without access. In addition, the results of the second stage Heckman model suggests that MSFHs that have access to land market will put about 11.44 ha more land under tree crops than those without access to land market. This effect is also positive and significant; but very small in magnitude for SSFHs.

x. First stage Heckman model reveals that land ownership increases the likelihood that MSFHs and SSFHs will own a tree crop farm by 38 per cent and 13 per cent respectively; while the results of the tobit model suggest that MSFHs and SSFHs owning land are likely to allocate a respective 29 per cent and 9.5 per cent more land to tree crops than those who do not own land.

xi. We observe from the results of first stage Heckman model that SSFHs with access to all-weather roads are 12 per cent more likely to own tree crop farms relative to those without access, while the tobit model reveals that farm households – irrespective of scale – that have access to all-weather roads are likely to allocate 7 per cent more land to tree crops than those who do not have access.

xii. The results of the tobit model reveal that MSFHs with access to agro-dealer services are likely to allocate 6 per cent more land to commercial tree crops than those without access. In addition, the results from the second stage Heckman model suggests that MSFHs that have access to agro-service dealers will tend to allocate about 0.64 ha more land to tree crops than those without access to agro-dealer services. These effects are not significant for SSFHs.

xiii. The results of the first stage Heckman model reveal that MSFHs headed by youths are 16 per cent less likely to own tree crop farms compared with households headed by non-youths. In addition, the results of the tobit model suggest that MSFHs headed by youths are likely to allocate 14 per cent less of their farmland to commercial tree crops relative to households headed by non-youths. These effects are insignificant for SSFHs.

xiv. The results of the first stage Heckman model suggest that the higher the value of farm asset that a SSFH possesses, the higher the likelihood that it would own a tree crop field. The tobit model shows that high value of farm assets increases the likelihood SSFHs would allocate a higher share of total farmland to tree crops relative to annual crops. The implication is that the likelihood of allocating more land to tree crop cultivation increases with an increase in the wealth of SSFHs as measured by value of farm assets. This effect is not significant for MSFHs.

xv. The results of second stage Heckman model shows that the coefficient of education is positive and significant for both SSFs and MSFs. This implies that more highly educated household heads tend to allocate larger area of farmland to commercial tree crops.

xvi. The results of the tobit model show that SSFHs that have access to large carriage vehicles for transportation of farm produce are likely to allocate 4.5 per cent more land to commercial tree crop cultivation relative to those without access. Furthermore, the results of the Heckman model suggest that MSFHs with access to large carriage means of transportation would, on average, cultivate 0.22 ha more land to tree crops compared with MSFHs without access to such means of transportation. Thus, increasing the availability of large carriage means of transportation and expanding the road infrastructure needed to support such a mode of transportation would be an important policy strategy for achieving expansion in land allocation to commercial tree crops plantation.

7.2 Conclusions

The findings of this study support the following major conclusions:

1. Tree crops cultivation as a pathway to agricultural commercialisation seem to be more popular with MSFHs relative to SSFHs in the study area.
2. Farm households that have access to land markets and all-weather roads or own land and have more farm assets are more likely to cultivate commercial tree crop fields.
3. Commercial tree crop farms tend to be larger for farm households that have access to land market and agro-dealers service, that have more highly educated household heads and that have access to better product haulage/transportation services.
4. Households that have access to land market, all-weather roads, agro-dealer services and own land are likely to allocate a larger share of cropland to commercial tree crops relative to arable crops.
5. The positive effects of access to land markets, all-weather roads and access to agro-dealers

services on land allocation to commercial tree crops cultivation are substantially higher in magnitude with MSFH compared with SSFH.

7.3 Policy implications

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. Results from this study revealed that less than 1 per cent of SSFs and 6 per cent of MSFs possess titles to their farmland. MSFs would be more motivated to invest in long gestation tree crop enterprises if they are assured that the land will not be taken away from them in the future against their will. This insecurity, which lack of ownership of land imposes on farm households, is even greater when it is considered that only 24 per cent of farm households are natives/indigenes of the farmland community. This is because the commonest source of land ownership is through inheritance, which is an indication of the failure of the land market. This problem of imperfect land market has been the bane of hectarage expansion in the Nigeria cocoa industry for several years now despite increasing efforts by government to encourage opening of new cocoa plantations.[9] Hence, policies that enhance security of farmland ownership among farm households could facilitate the redistribution of land in favour of commercial tree crops relative to arable crops in the crop mix of farm households in Ogun State, thereby enhancing the export potentials of both the state and Nigeria as a whole.

Secondly, policies that would increase access to agro-dealer services could lead to expansion in land under commercial tree crops enterprise especially among MSFHs. Use of agro-chemicals is especially important in boosting cocoa productivity and data from this study shows that only about 26 per cent of farm households who own tree crop fields have access to agro-dealers, from where inputs such as agro-chemicals and fertilisers can be obtained. 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 for transportation by farmers. Descriptive analysis of data generated by this study shows that only about 40 per cent of tree crop farmers have access to large haulage vehicles as means of transportation of farm produce. The majority depend on small carriage means of transportation like motorcycles, small cars etc. The fact that most of the tree crop growing landscape in Nigeria is located in rainforest vegetation worsens product transportation problems; especially during the rainy season. The bad roads make it difficult for large haulage vehicles to reach farm locations and many farmers have to make do with means of transportation with small carrying capacity such as motorcycles and other small vehicles. This results in a spike in the unit cost of transportation.

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 ZOP strategy aimed at expanding land area under tree crops in Nigeria. As shown by the results of this study, farmland operated by female-headed households is relatively smaller and the households' first priority is usually for food, which are mainly arable/annual crops. However, since tree crop farms could provide steadier and reliable sources of income for female-headed farm households, getting more of them involved in tree crop farming could substantially increase their income inflow and thus contribute substantially to improving child welfare outcomes.

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. The low level of youth engagement in tree crop farming as observed in this study is a major constraint to hectarage expansion in the tree crop sector. Policy intervention strategies could tap into the massive pool of unemployed or underemployed graduates of agriculture produced by Nigeria's tertiary education system over the past three decades. Anecdotal evidence suggests that a major source of discouragement for youths is the longer gestation period of tree crops such as cocoa, which can take between 5-7 years to achieve breakeven in net income. This problem is compounded by the difficulty in sourcing credit facilities for the initial capital/investment outlay. Thus, in order to encourage the youthful population to invest in tree crop enterprises, appropriate credit policies and programs will need to be put into place to absorb the burden of the initial cost of investment in the establishment of tree crop plantations.

The finding that MSFHs with access to fertiliser and machinery service are less likely to operate tree crop farms might be due to the need to recover production cost for the repayment of short-term credit facilities more quickly. The implication is that input policies focusing on increased access to fertiliser and machinery services are not likely to be effective in motivating farm households to expand land allocation to commercial permanent/tree crops while other things such as long-term credit facilities and access to land market are not in place.

Finally, the results generally tend to show that policy effects could be potentially stronger among MSFHs than SSFHs. This is because the estimated effects of many of the policy variables examined is stronger with MSFHs than SSFHs. Thus, encouraging the growth of MSFs may in fact help increase policy responsiveness to policies directed at area expansion for commercial tree crop production within the farm sector.

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APPENDIX

Appendix 1: Description of Model Explanatory variables

Variable	Description
Household characteristics	
Age	Age of the household head in years
Sex	If household head is male = 1, otherwise = 0
Marital status	If the household head is married = 1, otherwise = 0
Education	Years of formal education of the household head
Dependency ratio	Ratio of non-working members to working members of the household
Access to machinery services	If having access to machinery services like tractor or other machines = 1, otherwise = 0
Native	If household head is a native of the community = 1, otherwise = 0
Experience in farming	Number of years household head has been farming
Access of fertiliser	If having access to fertiliser use = 1, otherwise = 0
Livestock ownership	Measured as tropical livestock unit (TLU)
Family labour access	If household uses only family labour = 1, otherwise = 0
Hired labour access	If household uses some hired labour
Hired labour use (person days)	Continuous
Land ownership status	If household owns at least half of the land cultivated = 1, otherwise = 0
Area cultivated (Ha)	Size of the farmland being cultivated by household in hectares
Access to extension services	If there are extension visits to the household farms or by household members during last 1 year = 1, otherwise = 0
Land title ownership	Own land title = 1, otherwise = 0
Access to all-weather road	Access =1, otherwise = 0
Access to agro-service dealers	Access =1, otherwise = 0
Access to established markets	Access =1, otherwise = 0
Access to traders with large vehicles	Access =1, otherwise = 0
Off farm income	Continuous variable
Land area under household control	Continuous
Value of farm assets in terms of equipment	Continuous
Value of home assets	Continuous

Appendix 2: Distribution of pooled farm households by dependent and explanatory variables

Variable	Obs	Mean	Standard deviation	25th percentile	50th percentile	75th percentile
Dependent variables						
Share of tree crops in total farmland (per cent)	1064	0.2564	0.3612	0	0	0.5
Own tree crops field = 1	1064	0.4041	0.4910	0	0	1
Size of tree crop farm (ha)	430	9.1597	9.2334	4	6.6	10.85
Explanatory variables						
Age of household head (HHH)	1049	49.793	13.319	40	49	59
Sex of household head (Male=1)	1064	0.937	0.243	1	1	1
Marital status of HHH (married =1)	1064	0.923	0.267	1	1	1
Education of HHH (years)	1064	7.156	4.785	6	6	12
Access to machinery services	1064	0.0620	0.241	0	0	0
Native	1064	0.236	0.425	0	0	0
Youths (>36 years of age=1)	1064	0.1288	0.3351	0	0	0
Gross income (₦000)	1064	2350.88	4139.31	629.25	1236.00	2760.00
Experience in farming (years)	1064	20.112	12.256	10	19	28
Access to land markets	1064	0.3863	0.4871	0	0	1
Access of fertiliser	1064	0.244	0.430	0	0	0
Livestock ownership	1064	0.022	0.077	0	0	0
Family labour use	1064	0.700	0.458	0	1	1
Hired labour access	1064	0.133	0.339	0	0	0
Land ownership status (own land = 1)	1064	0.763	0.425	1	1	1
Area cultivated (ha)	1064	6.526	7.962	2	4	8
Access to extension services	1064	0.127	0.333	0	0	0
Land title ownership	1064	0.0303	0.171	0	0	0
Access to all-weather road	1064	0.883	0.322	1	1	1
Access to agro-service dealers	1064	0.257	0.437	0	0	1
Access to established markets	1064	0.474	0.499	0	0	1
Access to large haulage vehicles	1064	0.411	0.492	0	0	1
Off farm income (₦'000)	1064	291.39	684.22	38.00	120.00	279.30
Land area under household control (ha)	1064	10.55	24.18	2.85	5	11
Value of farm assets in terms of equipment (₦'000)	1064	20.87	65.54	6.30	11.98	23.59
Value of home assets (₦'000)	1064	352.11	470.34	36.20	83.40	170.00

Source: APRA Nigeria Field Survey, April/May 2018

Appendix 3: Distribution of small-scale farm households by dependent and explanatory variables

Variable	Obs	Mean	Standard deviation	25th percentile	50th percentile	75th percentile
Dependent variables						
Share of tree crops in total farmland (per cent)	569	0.1611	0.3138	0	0	0
Own tree crops field = 1	569	0.2566	0.4371	0	0	1
Size of tree crop farm (ha)	146	2.7932	1.0141	2	3	4
Explanatory variables						
Age	560	49.098	13.504	39	50	59
Sex	569	0.926	0.262	1	1	1
Marital status	569	0.914	0.281	1	1	1
Education	569	6.569	4.40	6	6	10
Access to machinery services	569	0.028	0.165	0	0	0
Native	569	0.165	0.372	0	0	0
Youth (< 36 years) = 1	569	0.1599	0.3668	0	0	0
Gross income (₦'000)	569	1099.62	1088.93	453.25	806.67	1310.50
Experience in farming	569	19.264	12.443	8	18	27
Access to land market	569	0.2671	0.4429	0	0	1
Access of fertiliser	569	0.144	0.352	0	0	0
Livestock ownership	569	0.019	0.074	0	0	0
Family labour access	569	0.754	0.431	1	1	1
Hired labour access	569	0.156	0.364	0	0	0
Land ownership status	569	0.738	0.440	0	1	1
Area cultivated (ha)	569	2.278	1.136	1.2	2	3
Access to extension services	569	0.074	0.262	0	0	0
Plot trekking distance	569	2.938	4.109	1	2	3.5
Land title ownership	569	0.007	0.083	0	0	0
Access to all-weather road	569	0.875	0.331	1	1	1
Access to agro-service dealers	569	0.237	0.426	0	0	0
Access to established markets	569	0.527	0.499	0	1	1
Access to large haulage vehicles	569	0.406	0.492	0	0	1
Off farm income (₦'000)	569	216.20	330.64	42.00	110.00	248.55
Land area under household control	569	4.05	5.19	2	3	4.4
Value of farm assets in terms of equipment (₦'000)	569	11.96	10.93	5.30	8.65	14.13
Value of home assets (₦'000)	569	131.91	216.57	29.05	73.20	143.23

Source: APRA Nigeria Field Survey, April/May 2018

Appendix 4: Distribution of medium-scale farm households by dependent and explanatory variables

Variable	Obs	Mean	Standard deviation	25th percentile	50th percentile	75th percentile
Dependent Variables						
Share of tree crops in total farmland (per cent)	495	0.3659	0.3808	0	0.2778	0.7222
Own tree crops field = 1	495	0.5737	0.4950	0	1	1
Size of tree crop farm (ha)	284	12.4325	9.8516	6.6	9.7	15
Explanatory Variables						
Age of household head (HHH)	489	50.589	13.071	40	49	60
Sex of household head (HHH)	495	0.949	0.219	1	1	1
Marital status	495	0.933	0.250	1	1	1
Education of household head (HHH)	495	7.830	5.115	6	6	12
Access to machinery services	495	0.101	0.302	0	0	0
Native	495	0.317	0.466	0	0	1
Youth (HHH <36 years) =1	495	0.0929	0.2906	0	0	0
Gross income (N'000)	495	3789.20	5624.01	1276.50	2550.00	4360.00
Experience in farming	495	21.087	11.976	12	20	28
Access to land market	495	0.5232	0.4999	0	1	1
Access of fertiliser	495	0.360	0.480	0	0	1
Livestock ownership	495	0.025	0.081	0	0	0.01
Family labour access	495	0.638	0.481	0	1	1
Hired labour access	495	0.105	0.307	0	0	0
Land ownership status	495	0.792	0.406	1	1	1
Area cultivated (ha)	495	11.412	9.498	6	8	13
Access to extension services	495	0.188	0.391	0	0	0
Land title ownership	495	0.057	0.231	0	0	0
Access to all-weather road	495	0.891	0.312	1	1	1
Access to agro-service dealers	495	0.279	0.449	0	0	1
Access to established markets	495	0.412	0.493	0	0	1
Access to large haulage vehicles	495	0.416	0.493	0	0	1
Off farm Income (₦'000)	495	377.82	931.49	35.00	136.80	334.00
Land area under household control (ha)	495	18.02	33.50	7	10	18
Value of farm assets in terms of equipment (₦'000)	495	31.12	94.39	10.40	19.50	32.50
Value of home assets (₦'000)	492	606.34	6894.78	45.00	103.90	216.30

Source: APRA Nigeria Field Survey, April/May 2018

ENDNOTES

1 The ERGP targets an average 16.5 per cent growth in total exports from 2017 to 2020 from oil and non-oil exports (FMBNP 2017). Evidence suggests that agricultural exports have grown since 2010; but the growth of 3.01 per cent in 2016 is far below the target set in the ERGP (9 per cent for all exports). The possibility of meeting the target set annually up to 2020 is even more difficult to guarantee. The slow progress in meeting the agricultural export target has become a matter of national concern and reliable information is needed on strategies to follow to achieve these export policy targets.

2 The ZOP involves the rolling out export policies for 22 major products, 11 of which are agricultural products such as beans, cocoa, cashew, cassava (starch, chips and ethanol), ginger, sesame, oil palm, yams, horticulture (fruits and vegetables), beef and cotton.

3 https://tradingeconomics.com/nigeria/agricultural-land-sq-km-wb-data.html https://www.theglobaleconomy.com/Nigeria/Percent_agricultural_land/

4 https://www.indexmundi.com/facts/nigeria/indicator/AG.LND.AGRI.ZS

5 The Nigeria Bureau of Statistics Trade report for the first half of 2019 shows that the top ten agricultural export crops in Nigeria are: sesame seeds (₦60.69 billion), fermented cocoa beans (₦31.05 billion), cashew nuts in shell (₦22.59 billion), quality raw cocoa beans (₦17.15 billion), cashew nuts, shelled (₦8.05 billion) , frozen shrimps and prawns (₦5.21 billion), ginger, natural cocoa butter (₦2.26 billion), agro-food items (₦1.84 billion), and sesame oil and its fractions (₦0.93 billion).

6 The identified sites were located in Anambra, Enugu, Kogi, Kebbi, Sokoto, Niger, Bayelsa, Taraba, Kano, Kwara, Lagos, Benue, Ogun, and Rivers states.

7 See Table 1.

8 See Muyanga et al. (2019) for more detailed exposition on the data collection process and features.

9 Aromolaran Adebayo, Milu Muyanga, Thomas Jayne and Jibayo Oyabade (2020): Shaking off Decades of stagnation in the Nigerian Cocoa Sector. APRA Blog posted February 6 2020 on https://www.future-agricultures.org/blog/shaking-off-decades-of-stagnation-in-the-nigeria-cocoa-sector/ ; https://bit.ly/397eQN4.

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