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IZA DP No. 17230

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ISSN: 2365-9793

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ABSTRACT

Land Access and Poverty among Agricultural Households in Nigeria*

The issue of land inequality has garnered renewed interest in development literature due to its potential impact on the welfare of smallholder farmers. Poverty reduction is a crucial sustainable development goal, and a clearer understanding of the factors contributing to poverty is essential for effective, targeted policy initiatives in Nigeria. Investigating the potential relationship between land access and household poverty-related outcomes is highly relevant for both land and social welfare policy and is the focus of our paper. Using data from the four waves of the Nigeria General Household Panel Survey (GHS), we examine how the amount of land an agricultural household operates and the value of that land affect the probability of living in poverty. We employ both a fixed effects and a correlated random effects approach to explore our research question. Our results suggest a significant relationship between land access, as measured by land size, and poverty incidence. We also find evidence suggesting nonlinearities in the relationship between land access and poverty.

JEL Classification: Q15, Q12, D31, I32, I30, O1
Keywords: land access, land value, Nigeria, poverty, land size, inequality

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* Comments are appreciated.

1 Introduction

Poverty is a significant problem in Nigeria. According to the World Poverty Clock (2023), Nigeria ranks highest across all countries in the number of people living in poverty. Rural poverty is especially of concern because a sizable percentage of households either as wage or self-employed agricultural workers experience poverty linked to weak markets, conflict, institutions, and the distribution of productive assets. In the past literature, access to land has been suggested as a potentially effective approach to rural poverty reduction (see Warriner, 1969; Thiesenheusen, 1989; Dorner, 1992; Binswanger et al., 1995; Finan et al.,2005). Yet, recent evidence supporting this hypothesized relationship is scant. The rationale for the thesis that land can mitigate poverty is the well-established link between land access, farm productivity, and increased income and expenditure. Given the current limited empirical research that considers how land access affects the welfare status of households, especially those at the bottom of the income distribution, our paper aims to begin to bridge this gap. Our focus on Nigeria is intentional given the rising levels of poverty, its significant population of small holder farmers, and the role of agriculture in the economy.

One factor contributing to high and rising poverty rates in Nigeria explored in the past literature is conflict (see Odozi and Uwaifo Oyelere 2021). In this paper, we investigate another potential factor - access to land. Land is an important productive asset held by households in most rural economies. As a productive asset, it generates income from the sale of crops, and wage payments for households supplying their labor to other farms. The total agricultural land in Nigeria is seventy-five percent (68.493 million) of its total land area (91.077 million hectares)(FAOSTAT database) which is significant. Statistics from the Food and Agriculture Organization show that of the total agricultural land, cropland accounts for sixty-three percent(63.33%)

while permanent meadows and pasture account for 36.67% (FAOSTAT database).

It is worth noting that except for livestock which is mostly on free range and insignificant ranching, a disproportionate amount of agricultural land is allocated to a variety of arable and permanent crops. For example, in 2021, seventeen major crops cultivated accounted for 76% [52.26 million hectares] of the total agricultural land (NAERLS and FMARD,2021)[1]. This recent statistical data suggests that the cropland area has expanded into areas designated for permanent meadows and grazing. However, despite this expansion in available cropland areas, accessing land for agriculture remains a major challenge among many farming households. The dearth of sufficient agricultural land has been linked with faster growth in population than in the availability of arable land despite the increase in urbanization between 1970 and 2010. Accordingly, population pressure has led to the decline in per capita landholding.[2] According to FAO, the ratio of cropland to agricultural population declined from 0.5 hectares to 0.2 hectares between 1970 and 2021 (FAO Statistics). Land scarcity or lack of access to land is especially a significant challenge in areas of high population density. The significant decline in per capita landholding coupled with rising poverty are the primary motivation for our research question. Our main objective is to examine whether land access affects poverty for smallholders in Nigeria. In particular, we focus on establishing the relationship between land access and welfare as measured by poverty at the household and LGA levels which has not yet been investigated using data from Nigeria. We are also interested in testing for nonlinearities in this relationship.

[1] The crops are: rice, maize, sorghum, millet, cowpea, groundnut, soybean, beniseed, yam, cassava, cocoyam, cotton, ginger, tomatoes, onion, okra, and plantain Plantain (NAERLS and FMARD,2021)

[2] Population grew from 55 million to 160 million between 1970 and 2010(World Bank Data Base), urbanization grew from 16% to 40 % over the same period (Alemu et al., 2015).

There are contrasting views on the effects of landholding on income and poverty. Land access inequality refers to the disparity in land access between households and groups. Related to this is the concept of farm size distribution. Land access is not limited to land ownership or the amount of land that is operated; it is a broad concept encompassing other dimensions, such as the value and productivity of the land, the level of security of tenure, actual control of the land, and the ability to appropriate value from it. In this study, we view land access as landholding, which includes the size and value of the land that people access or hold, whether through purchase, rental, or inheritance.

To address our research questions, we primarily use data from the four waves of the Nigeria General Household Survey (GHS) panel. We estimate both a fixed effects (FE) model and a correlated random effects (CRE) model to explore this potential relationship. We also test for non-linearities in this relationship. Given the potential limitations of the fixed effects model estimates, particularly if there are time-varying unobservables correlated with both land size and poverty, we also explore an LGA-level regression model. In this case, we examine whether the available land in an LGA affects the incidence of poverty in that LGA. Additionally, we test whether the value of the land influences the probability that a family is poor.

Our results suggest a significant negative relationship between land access and poverty. Specifically, we find that increased land size reduces the probability of a household being in poverty. However, we do not find compelling evidence of a relationship between real land value and poverty.[3] We also find some evidence suggesting nonlinearities in the relationship between certain land access measures and poverty, though this finding is not consistent across all measures.

Our research contributes to the literature by providing the first comprehensive

[3] In the few models where a significant effect is noted, the coefficient is small and negligible.

analysis of the relationship between land size, land value, and poverty in Nigeria using panel data. While there is a growing body of literature on this topic in many other developing countries, research in Nigeria is lacking, to the best of our knowledge. Moreover, most existing research has focused directly on the link between cropland holding and expenditure or income. We, however, consider the link between poverty and both the size of land a household has access to and the value of this land. Our results are important because we find significant impacts of land size and some evidence of the importance of land value. Given past research suggesting that recent increases in poverty have been tied to exogenous factors such as conflict, focusing on poverty reduction is a social justice issue and a priority for the Nigerian government. While we do not suggest that dramatic reductions in poverty in Nigeria will result solely from increased access to land, our results indicate that increasing land access can decrease the probability that a household is poor. Therefore, increasing land access should be part of a multi-dimensional approach to mitigating poverty in Nigeria.

The rest of our paper proceeds as follows. In section 2, we provide some institutional context on land in Nigeria. In section 3 we provide a review of the past literature. In section 4 we describe the data. In section 5 the empirical framework is presented. Section 6 summarizes our results and provides robustness checks. We conclude in the last section.

2 Institutional Context of Land Access in Nigeria

In Nigeria, the institutional environment for land allocation and use rights has evolved. Even before Nigeria's independence, both formal and informal institutions administered land use rights to individuals or groups of people, but with some variation across regions (see Ghebru and Girmachew, 2017); Ghebru and Okumo 2016). Almost two decades after independence, the legal and constitutional framework for land use rights and ownership was promulgated as “the Land Use Act of 1978” by the then Military Government. This marked a unified governance of land resources in Nigeria. The law categorized land tenancy into customary occupancy rights for rural lands and statutory occupancy rights for urban lands. Lands in urban areas are vested in state governors while rural lands are vested in local governments(Etowa and Nwiido, 2019, Ghebru et al.,2014)). The major land tenure systems presently in Nigeria includes: the informal, statutory and customary tenure systems.

One of the many challenges in the rural areas post the 1978 Land Use Act is that only limited number of rural households have their land use rights registered. Ghebru and Girmachew, (2017) suggest that this is due to information gaps and costly and bureaucratic registration processes. In 2009, a second round of land reforms began. Insecurity of land accessed through the customary system, and the difficulty in land transfer instigated the land market-based reforms. Land reform efforts continue in Nigeria currently and the aims of the current efforts following the 2009 market-based land reforms are to improve tenure security, facilitate the growth of land markets, and provide public access to land records (Ukaejiofo and Nnaemeka 2014; Ghebru and Girmachew, 2017). Despite the 1978 state-led land reform, the most recent data from the National Bureau of Statistics suggests that 84% of smallholder households still gain access to land via the customary tenure system. Hence, there is still a lot more that has to be done if the government aims to foster alternative tenure systems in rural communities.

3 Literature review

There is a growing body of literature investigating the importance of land in agricultural economies. The issue of land ownership inequality has long occupied agricultural and development economists and is viewed as a correlate of income inequality (Cipollina et al., 2018; Barrett, Carter, and Little, 2006; Carter, 2003; Baulch and Hoddinott, 2000; Besley and Burgess, 2000), particularly in communities where agriculture plays a key role in the economy. Land inequality is associated with exclusionary growth that perpetuates poverty through mechanisms such as human capital formation, credit markets, and institutions. This has led to a shift in focus towards questions such as how changes in farm size affect the welfare of agricultural households. Answers to these questions deepen our understanding of the role of land in poverty reduction.

While some studies find a small welfare effect of land access (Lopez and Valdes, 2000; McCulloch and Baulch, 2000), others argue that having land does not necessarily lead to poverty reduction (Ravallion and Van de Walle, 2008) because the prevalence of economic and natural risks often creates losses for farmers cultivating land (Easterly and Kraay, 2000; Winters, McCulloch, and McKay, 2004). Despite these differences, several past studies exploring the relationship between farm size and income show a significant positive association.[4]

For example, Finan et al. (2005) argued for the important role of land access in poverty reduction and attributed the low marginal value estimates in previous studies to inappropriate methodologies. In contrast, they employed a non-linear welfare equation, in which the outcome variable is linked to dwelling characteristics, house-

[4] See Kinsey 1999; Ellis and Bahiigwa 2003; Ellis and Mdoe 2003; Jayne et al. 2003; Burgess 2001; Bigsten et al. 2003; Finan et al. 2005; Scott, 2000; Gunning et al., 2000; Grootaert et al., 1997; and Carter and May 1999.

hold durables, expenditure, and non-farm income using a principal factor component. They found a higher marginal value of land, a larger welfare effect for small plots, and varying estimates based on a household's complementary assets and contextual setting.

Based on their findings, they argued that the prevalence of credit and labor market imperfections prevents many households from maintaining production intensity as land area increases. Using a theoretical household income model, they showed that while access to land directly affects a farmer's income through increases in output per unit of land and employment, inefficiencies in the allocation of production factors indirectly impact a farmer's income. Their findings support Barrett's (1996) earlier concerns that an increase in land productivity for small farm sizes may not necessarily indicate an improvement in smallholder welfare. Moreover, there is a contention that the estimated increases in farm output only partially translate into income gains (López and Valdés, 2000).

Similarly, Chamberlin and Jayne (2019) used inter-district data specific to Tanzania on farmland holding distribution and household income. They employed the Gini coefficient, skewness, coefficient of variation, and ratios as measures of land inequality, using household and community covariates as explanatory variables in the econometric regression. They found significant effects of landholding on income. Bandeira and Sumpsi (2011), focusing on Guatemala, also noted significant effects when investigating the relationship between agricultural land access and consumption using cross-sectional data.

While most of the past literature suggests a negative relationship between land access and poverty, more recent research indicates that nonlinearities may exist. For example, Nguyen and Tran (2014) analyzed the relationship between landholding and welfare using a rural household panel dataset from Vietnam, noting a U-shaped relationship between cropland and both per capita expenditure and per capita income. Their findings suggest that at lower levels of cropland holding, increases only reduce expenditures and income, and it is only above a certain threshold that increased landholding raises income. They also note a negative relationship between cropland and expected poverty.

The relationship between land size and output yield has also been established in past literature. For example, the hypothesis of an inverse relationship between farm size and productivity has been investigated using both plot and farm datasets (see Vollrath, 2007; Barrett et al., 2010; Heltberg, 1998; Frisvold, 1994; Feder, 1985; and Carter, 1984). Vollrath (2007), in particular, plotted output per hectare against land inequality, measured by the Gini coefficient, using cross-country data. They found that the Gini coefficient for landholdings has a significant negative relationship with productivity. In other words, the less inequality in access to land, even if the land size is small, the higher the output per unit of land. Despite this output advantage, the hypothesis of the inverse land size-productivity relationship has been the subject of various explanations. One common explanation has been smallholder crop production technology. Other pathways include factor market imperfections that drive inefficient resource allocation.[5]

The takeaway from the current empirical literature is that there is no clear consensus on the relationship between land access and welfare. The impact of land on welfare has been both positive and negative in past studies, and in some cases, nonlinearities have been noted. Therefore, significant heterogeneity could exist across countries depending on institutional history and land tenure systems. Given this context, a comprehensive study on Nigeria, which is our objective in this paper, is both needed and valuable.

[5] See Barrett, 1996, for more details on the various explanations.

4 Data Description

To estimate the effect of land size and land value on poverty we make use of the Nigeria General Household Survey (GHS). There are four waves currently of the panel: 2010, 2012, and 2015, 2018 [see National Bureau of Statistics (NBS)(2019), NBS (2016), NBS (2014), NBS (2012)]. The GHS−Panel originally consisted of about 5000 households. This panel survey is a nationally representative survey of the geopolitical zones in Nigeria It covers both the urban and rural areas.

As noted on the World Bank's Central Microdata Catalog website, the GHS is implemented in collaboration with the World Bank Living Standards Measurement Study (LSMS) team as part of the Integrated Surveys on Agriculture (ISA) program. In 2010, it was revised to include a panel component (GHS-Panel). The World Bank in its description of the data also emphasizes that the panel data survey was launched to track the socio-economic changes over time in farm and rural households. All households within the survey had to fill out a multi-topic Household Questionnaire. As described on the survey website, the questionnaire includes information on demographics, education, health, employment, common anthropometric measurements, various income sources, housing, food and non-food consumption and expenditures, and asset ownership. There is also a detailed agricultural questionnaire module with observations on geo-referenced plots, plot-level information on input use, cultivation, and production, information on household members that manage and/or own each plot, and information on labor input at the plot level. We will leverage the agricultural module in our study.

It is also important to mention that for the first three waves of the GHS survey, only a few additional households were added to the survey. For the fourth wave (survey of 2018/2019), a major change was implemented. Specifically, a significant number of households in the prior three panels were dropped and 3600 new households were added to replace the dropped household. These households were referred to as the 3,600 refresh households. Only 1,507 households from the original 2010 panel were re-interviewed in 2018.[6]. This significant change combined with the normal marginal attrition of households given the length of time since the survey began, reduces significantly the size of the balanced panel over the four waves. See Table 1 for the exact sample size information. While the World Bank specifically stated that this sub-sample of about 1507 households, that allows a continued longitudinal analysis for the sample going back to 2010, was designed to be nationally representative, its small sample size creates some estimation challenges. In particular, using the balanced panel over 4 years can lead to insignificant estimates when required econometric analysis is data intensive.[7] Table 1 provides summary statistics for key variables used in the analysis for the full sample and the balanced panel. Given the aforementioned issues related to the refresh sample, we provide summary statistics for both the four waves panel and the three wave panel.

5 Empirical Framework/Strategy

To address our main question of interest—estimating the effects of land access on poverty—we employ two estimation strategies: Fixed Effects (FE) and Correlated Random Effects (CRE). Several authors in the past literature have explored different functional forms in attempting to estimate the relationship between land access and expenditure or poverty. Following Finan et al. (2005), we first assume a linear relationship between our variable of interest—land access—and poverty, as shown in

[6] See the World Bank micro-data website for more details on the sampling https://microdata.worldbank.org/index.php/catalog/3557#metadata-sampling

[7] We discuss how we deal with this challenge in the empirical framework section of the paper.

equation (1).

The linear FE model of a household i at time t is expressed as:

$$Y_{it} = \alpha + La_{it}\beta + DL_{it}\Phi + X_{it}\gamma + T_t\rho + \theta_i + \mu_{it} \tag{1}$$

Where La_{it} represents our measure of land access for household i in period t, DL_{it} represents the measure for landless is a dummy and takes a one if a household has no land and 0 otherwise, X_{it} represents the covariates consisting of household and community variables, T_t represents the time year dummy, and the time-invariant unobserved variable for the household is represented by θ_i. The error term is represented by μ_{it}. μ_{it} is assumed to be a zero-mean error term uncorrelated with La_{it}, $DL_{it}$and X_{it}. The parameters of interest are β and Φ and they capture the effects of land access on poverty.

Subsequently, we test for nonlinearities in the relationship between our measures of land access and poverty by reestimating our model including a quadratic component for the land access variable as in equation (2).

$$Y_{it} = \alpha + La_{it}\beta + La_{it}^2\chi + DL_{it}\Phi + X_{it}\gamma + T_t + \theta_i + \mu_{it} \tag{2}$$

As noted above, we first estimate a fixed effects (FE) model. Our rationale for using this approach is reasonable given the structure of the available data set that allows observation of the same household over several rounds. Y_{it} our dependent variable is a binary indicator known as the headcount poverty measure. It belongs to the Foster-Greer-Thorbecke(FGT) class of poverty measures (Foster et al., 1984). The dependent variable is dichotomized where the value of 1 indicates that a household is living in poverty (on or below the poverty line) and a value of 0 indicates that the household is above the poverty line. The poverty line is determined following Odozi and Uwaifo-Oyelere, 2023. In particular, the poverty line for each year of data is derived using information from the World Bank (WB). The World Bank captures baseline levels of income per day that identifies individuals in extreme poverty. We adopt these poverty lines which are set in dollars and convert these poverty lines to Naira (local currency) using the relevant exchange rates for each year of data. While household income is commonly used to identify poverty, we instead identify households in poverty using their consumption expenditure.[8] Our key explanatory factor is La_{it} - land access. As noted in the introduction, the measure of land access is not limited to the amount of land that a farmer owns or operates, it is a broad concept that encompasses other dimensions. In this study, we explore four different measures or proxies of land access in separate equations.

1. Landholding: This is a continuous variable measured in meters squared using the Global Positioning System (GPS). We convert this measure of land size to acres for ease of interpretation given the country context.

2. $\frac{LandHolding}{HouseholdSize}$ This measure is linked to the first measure. We simply normalize the landholding variable by the household size leading to a transformed variable we define as landholding per capita. We also measure this in acres.

3. Land value: This is a continuous variable measured in naira (local currency) and captures the self-assessed value of farmers' landholding. Given the significant devaluation of the naira over time, we measure this in thousand naira.

4. $\frac{LandValue}{HouseholdSize}$ is our fourth measure of land access and is simply derived by normalizing the land value estimate by household size. It is also measured in thousand naira.

[8] See Odozi and Uwaifo-Oyelere, 2023 for a discussion of why using consumption is preferred instead of income.

We include the value of the land as a measure of land access because it is determined by the quality and locational characteristics of the land, which are known to vary considerably across farming households. In all our models, we also include a land dummy variable. This binary variable takes the value of 1 if the household is landless and 0 if the household has access to land. In all equations, we control for household characteristics and for community characteristics that vary at the LGA level, such as population density and climate, measured by rainfall. We also control for social and economic variables at the LGA level, including access to market-related, social-related, and health-related community infrastructures.[9] Given that past research has provided evidence of the role of conflict on welfare, we control for exposure to violent conflicts in Nigeria using two measures from Odozi and Uwaifo-Oyelere (2021): recent conflict exposure and accumulated conflict exposure.[10]

In section 4 of the paper, we highlighted that the implementation of the refresh sample in 2018 introduces some challenges. These challenges arise because the balanced panel over the four waves is small, and one of the limitations of FE estimators is the heightened measurement error in the explanatory variables when the sample size of observations is small. Given our concern about deriving insignificant effects in the small balanced sample of the four waves due to this heightened measurement error, we first leverage the larger balanced sample from the first three waves. Recall that it is only in the fourth wave that a significant number of original households

[9]Health-related community infrastructure includes the number of days/weeks of access to health centers, pharmacies, dentists, private doctors, midwives, private clinics, private hospitals, and public hospitals, and is measured by the number of these in the LGA. Market-related community infrastructure is constructed using information on the number of commercial banks, microfinance banks, markets, and community centers in the LGA, while social-related community infrastructure is constructed using access to post offices, fire stations, places of worship, police stations, nursery schools, primary schools, secondary schools, internet cafes, and bus stops. It is also measured by the number of these infrastructures in the LGA.

[10]See Odozi and Uwaifo-Oyelere (2021) for details on the construction of these variables.

are dropped. Specifically, we first estimate our empirical model using only the 2010, 2012, and 2015 waves. We then reestimate the model using all four waves of data. However, for the four waves, we focus on the unbalanced sample for this estimation.

The main challenge in obtaining unbiased and consistent estimates of the parameters in Equation (1) is the possibility that our variable of interest—land access—could be correlated with unobservables that are also correlated with poverty status. In non-randomized studies, that is, studies that are not experimental, methods such as fixed effects and instrumental variable techniques have been widely used to address such issues. The fixed-effects methodology eliminates the unobserved time-invariant variables, θ_i , highlighted in Equation (1). However, the FE estimator does not eliminate all potential sources of bias. It is limited in its ability to control for endogeneity bias arising from unobserved variables that are time-variant and affect both our poverty variable and landholding. For example, if a household's connection to local authorities is time-variant and agricultural households that are better connected to local authorities are more likely to have more landholding and higher income, they are less likely to be in poverty.

One way to reduce this potential source of bias is to employ an instrumental variable approach. However, this is not an option for us given the challenge of finding a valid instrument. An alternative is to include a rich set of observed time-varying covariates that are not traditionally included in a basic empirical welfare model but could be added to the estimated equation to reduce potential bias stemming from unobserved time-varying variables.

We also explore the relationship between land access and poverty at the LGA level using an empirical model similar to Equations (1) and (2). Specifically, we calculate the LGA averages of all control variables in our empirical model by year. For our variable of interest, land access, we calculate the total landholdings and total value of land in each LGA by year. In this case, our dependent variable is the poverty incidence at the LGA level by year. Similar to our analysis at the household level, we estimate this LGA model using a fixed-effects strategy.

Given that in this scenario the control variables and dependent variables are averages at the LGA level, while the variable of interest is an aggregate for the LGA, the possibility of time-varying unobservables at the LGA level being correlated with total landholdings, total land value, or poverty incidence is attenuated. In particular, when we estimate FE models at the household level, it is more plausible that there could be time-varying unobservables at the household level, leading to an endogeneity problem. In contrast, when we aggregate to the LGA level, the likelihood of a variable varying over time that affects poverty in the LGA, total LGA cropland area or value, and is unobservable becomes less tenable.

The FE estimator we use in our analysis is best suited for continuous dependent variables. The challenge is that our dependent variable, poverty incidence, is binary. Therefore, when estimating Equations (1) and (2), we are assuming a linear probability model. However, binary variables are better suited for probit or logit models. Unfortunately, there is no conditional fixed-effects probit estimator, and with small T, as is the case here and with most panels, the incidental parameter bias is significant. In addition to the incidental parameters problem, there is the issue of correctly computing standard errors for the parameter estimates.[11]

To address this challenge and account for the nonlinear binary nature of our dependent variable, as a robustness check, we reestimate our models using the Correlated Random Effects (CRE) probit model (see Wooldridge 2019). This model includes household-level time averages in addition to the control variables in Equation (1). We also include zone and time dummy variables, as well as interactions

[11] This is especially relevant for the average partial effects.

between zone and year dummies, to control for time-varying zone effects. In every estimation of the CRE model, we compute robust standard errors and cluster the standard errors at the household level to account for the possibility that household decisions may be correlated over time.

6 Results

Table 2 provides a summary of four Fixed Effects (FE) models using the balanced panel from 2010-2015. In the results summarized in column (1), we included the land access measure—total landholding in acres. For the results summarized in columns (2), (3), and (4), we use alternative measures of land access: $\frac{landholdingacreage}{HHsize}$, land value and $\frac{landvalue}{HHsize}$, respectively.

The results in Table 2 indicate a significant negative effect of landholdings (measured in acres) on poverty incidence. This finding suggests that increasing cropland holdings reduces the probability of being poor. However, no significant effects were found for the other three measures of land access in the models summarized in Table 2. [12]

Table 3 corroborates the results in Table 2, though with slight differences. The results in Table 3 summarize the findings from re-estimating the four models presented in Table 2 but using a longer balanced panel (2010-2018). Table 4 also summarizes results using the four waves but without the balanced panel sample constraint. The sample used in Table 4 is an unbalanced panel data sample (2010-2018). In the

[12]Note that in Table 2, the dummy variable indicating landlessness is statistically significant and negative in all four models. This suggests that, on average, those involved in agriculture and possessing land are more likely to be poor than those who are landless, which includes both the landless in agriculture and all non-agricultural households. This is not unexpected, as many non-farm households are involved in more stable wage work, reducing their vulnerability and the likelihood of poverty. The landless who are agricultural households represent a small percentage of all agricultural workers.

results summarized in Table 3, only total landholdings appear significant among the land access measures, whereas in Table 4, both landholding and normalized landholding measures are significant and negative. However, the other two land access measures and the land dummy variable are not significant.

Tables 5-7 summarize the results of models testing for nonlinearities in the relationship between land access and poverty. Similar to Tables 2-4, the sample used for estimating the results in Table 5 is the balanced panel (2010-2015), in Table 6, the balanced panel (2010-2018), and in Table 7, the unbalanced panel (2010-2018). We find evidence that confirms the poverty-reducing effect of increased landholdings noted in Tables 2-4. In Table 5, our first two measures of land access show a significant relationship, while the third and fourth measures, which capture real land value, are insignificant. In Table 6, apart from the two significant measures in Table 5, real land value is also significant and negative, suggesting that an increase in real land value decreases the probability of a household being in poverty. The results in Table 7 corroborate those in Table 6, with the first three land access measures being statistically significant.

We also find some evidence of nonlinearities in the relationship between poverty and land access. In the results summarized in columns (2) and (3) of Tables 5, 6, and 7, the square term for our land access measures is statistically significant, though the coefficient size is negligible. These results together suggest that as household per capita landholding increases, poverty decreases up to a certain point. However, this relationship is nonlinear and could be U-shaped. The land access parameter estimate is negative, while the squared term is positive. These findings suggest that beyond a certain threshold, increased normalized landholding or real land value could increase the probability of being poor. The land dummy is again significant in the balanced panel (2010-2015) results (Table 5) but is insignificant in both the balanced and unbalanced panel estimations (2010-2018) in Tables 6 and 7. This contrasting finding may suggest that the parameter estimate for the dummy is unstable, but further investigation is required before drawing any conclusions.

Tables 8 and 9 provide summaries of the LGA-level analysis results. In both tables, columns (1) and (2) present estimates using the unbalanced panel (2010-2018), while columns (3) and (4) provide estimates using the balanced panel sample (2010-2015). For the LGA-level analysis, we consider only two land access variables: aggregate LGA cropland size in acres and aggregate LGA real land value. In both tables, the results for aggregate LGA land size are summarized in columns (1) and (3), and those for aggregate LGA real land value are in columns (2) and (4). Table 8 presents the results for the standard models, while Table 9 presents the results from models that include a quadratic term for the land access variable.

The results are generally mixed and relatively weak. While there is some evidence of a negative effect of land size on poverty incidence in LGAs (Table 8, column (3), and Table 9, column (3)), the average real land value in an LGA is insignificant in the models summarized in both Tables 8 and 9. Moreover, the land size variables are not significant in the unbalanced panel sample (2010-2018). With respect to the land dummy, it is negative and significant in the balanced sample (2010-2015) but insignificant in the unbalanced sample. The results from the balanced panel suggests that the higher the proportion of an LGA that is landless, the lower the poverty incidence in the LGA. As noted above, the landless include wage workers and other kind of entrepreneurial activities that typically lead to higher income levels reducing the likelihood of being in poverty.

Given the mixed results, particularly for the land size measure in the LGA regressions, we cannot draw broad inferences from these findings. One possible explanation for the insignificant results in the unbalanced panel is decreased precision due to increased measurement error, as households with shorter panel lengths are included in the estimation sample.

As noted in our empirical framework, our dependent variable, poverty, is binary, so estimating a Fixed Effects (FE) model under the assumption of a linear probability model could lead to predicted probabilities outside the unit interval. As a robustness check, we estimate Correlated Random Effects (CRE) probit models. The results of these models are summarized in Tables 10-13. For brevity, we only present the land access measures in these tables. Similar to Tables 2-4, Tables 10-12 present the results using each of our land access measures. Specifically, in column (1), we include the estimates from the CRE model with cropland size in acres, and in column (2), the estimates from the CRE model with $\frac{LandHolding}{HHsize}$, also in acres. In column (3), we include the estimates from the CRE model with real land value per thousand naira, and finally, in column (4), the estimates from the CRE model with real $\frac{landvalue}{HHsize}$.

In Tables 10 and 12, the sample used for the estimations is the balanced panel (2010-2015), while in Tables 11 and 13, the sample used is the unbalanced panel (2010-2018). Tables 10 and 11 estimate the standard empirical model, while in the models summarized in Tables 12 and 13, we include the quadratic term for the land access variables.

Given the difficulty in interpreting probit estimates, we present the marginal effects of the estimated parameters in Tables 10-13. The results support our FE estimates and inferences. In both Tables 10 and 11, we find evidence of a negative relationship between land size and poverty. Both land size acreage and normalized land size in acres are statistically significant. In contrast, estimates using real land value measures and $\frac{landvalue}{HHsize}$ are not significant.

When we include the quadratic term in both Tables 12 and 13, the results remain consistent: land size access measures are significant, while land value measures are not. Regarding nonlinearities, the quadratic term for both land size and normalized land size ($\frac{landsize}{HHsize}$) is not significant. In contrast, the quadratic term for land value and $\frac{landvalue}{HHsize}$ is significant, but the effect is negligible. [13]

The results in Table 1-13 provide ample evidence that land access affects welfare. In particular, we find significant support for the effect of cropland size on the probability an individual is poor. We find less consistent evidence of the effect of real land value on the probability an individual is poor. In addition, we find some evidence of nonlinearities in this relationship but it appears this only applies to specific land access measures. It is worth mentioning that the estimated coefficients on land value variables are really small but this is not so surprising because land is expensive and a 1000 naira change is a relatively small change.

7 Summary and Conclusion

Land is a significant productive asset in most rural economies of developing countries, making it a potential channel for improving rural incomes and reducing poverty. Despite the importance of land and the well-established relationship between farm size and output, empirical research on how land access affects the welfare of households—particularly those at the bottom of the income distribution—is limited. This gap is especially pronounced in Nigeria, compared to countries in Latin America and Asia, where estimates of this relationship have been established, albeit with some debate. The lack of such estimates is surprising for Nigeria, where poverty continues to rise, and the country ranks first in the world in terms of the number of people living in poverty. Our focus is on establishing the relationship between land access and welfare, as measured by poverty, at both the household and LGA levels.

[13] As in earlier models, the land dummy is negative and significant in most cases.

To address our research questions, we primarily use data from the four waves of the Nigeria General Household Survey (GHS) panel. We estimate both a Fixed Effects (FE) model and a Correlated Random Effects (CRE) model to explore this potential relationship, and we also test for nonlinearities. Given the potential limitations of the fixed effects model estimates at the household level, particularly when there are time-varying unobservables correlated with the variables of interest and the dependent variable, we also explore an LGA-level regression model. This allows us to test whether the available land in an LGA, both in terms of access and value, affects poverty incidence at the LGA level.

Our results suggest a significant negative relationship between increased land size and poverty. While we find some evidence that the higher the estimated value of land a farm household owns or has access to, the lower the probability of being poor, in most cases, we do not find a consistent relationship between real land value and poverty. We also do not find consistent evidence supporting nonlinearities in the relationship between our land access measures and poverty. Providing evidence of the significant effect of land size is important and a valuable addition to the literature. Given past research suggesting that recent increases in poverty have been tied to exogenous factors such as conflict, a focus on poverty reduction is both a social justice issue and a necessity for the Nigerian government. Our findings support the inclusion of increased land access as part of a multidimensional approach to poverty reduction in Nigeria.

Going forward, this study serves as an entry point for understanding land access inequality in Nigeria in greater detail. It also provides a solid foundation for further studies that explore: first, the socioeconomic inequalities in land access and their impact on output outcomes; second, the pathways linking land access to poverty and food security outcomes; third, the migration decisions related to land access;

fourth, the transition from land insufficiency to land sufficiency and vice versa among smallholder farmers; and finally, the role of landholding during structural change and land reforms.

Tables

Table 1: Summary Statistics: Mean and Standard Deviation

	All(2010 - 2018) (1)	All(2010 - 2015) (2)	Bal.Panel(2010-2018) (3)	Bal.Panel(2010-2015) (4)
Per adult equivalent Poverty Incidence	0.295	0.281	0.295	0.285
	(0.456)	(0.449)	(0.456)	(0.451)
Land Access in Acres	2.134	2.054	2.219	2.061
	(4.309)	(3.280)	(3.327)	(3.276)
Land Access/Household Size	0.377	0.351	0.368	0.353
	(1.022)	(0.724)	(0.693)	(0.728)
Real Land Value in '000 ₦	1345.228	911.3816	1071.814	904.6641
	(11992.11)	(3012.866)	(2952.239)	(3025.971)
Real Land Value in '000 ₦/ Household Size	263.413	176.7865	206.6519	176.1455
	(1590.701)	(815.171)	(627.169)	(819.307)
Landless Dummy	0.083	0.048	0.085	0.048
	(0.276)	(0.214)	(0.280)	(0.214)
Sector	0.375	0.386	0.397	0.371
	(0.484)	(0.487)	(0.489)	(0.483)
Years of Schooling	7.560	6.628	8.041	6.521
	(6.260)	(5.797)	(6.275)	(5.766)
Age in years	51.389	52.043	51.465	52.246
	(14.995)	(14.905)	(13.435)	(14.906)
Age squared in years	2865.632	2930.599	2829.057	2951.791
	(1657.856)	(1665.378)	(1449.062)	(1668.114)
Household Size	6.380	6.409	6.774	6.424
	(3.383)	(3.261)	(3.304)	(3.220)
Population Density	2201.880	2194.126	3406.116	2150.412
	(6513.756)	(6316.590)	(9126.641)	(6271.908)
Rainfall in millimeters	1594.744	1534.614	1610.951	1538.628
	(801.963)	(741.240)	(865.936)	(745.881)
Recent Conflict Exposure	0.005	0.004	0.004	0.004
	(0.024)	(0.025)	(0.020)	(0.025)
Long Conflict Exposure	0.017	0.014	0.014	0.014
	(0.066)	(0.056)	(0.042)	(0.056)
No. Market Infrastructure	1.544	1.466	1.623	1.529
	(1.268)	(1.306)	(1.243)	(1.294)
No. Social Infrastructure	3.738	3.537	4.076	3.694
	(2.114)	(2.129)	(2.049)	(2.038)
No. Health Infrastructure	2.560	2.416	2.797	2.520
	(2.360)	(2.314)	(2.424)	(2.308)
N	17098	12726	3859	12270

Note: Standard deviation in parentheses.

Table 2: Land Access and Poverty (Bal. Panel 2010-2015)

	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty
Land access in Acres	-0.006861***			
	(0.002)			
Landless Dummy	-0.068596**	-0.062622**	-0.056549*	-0.056714*
	(0.030)	(0.031)	(0.031)	(0.031)
Years of Schooling	-0.004844*	-0.004837*	-0.004891*	-0.004897*
	(0.003)	(0.003)	(0.003)	(0.003)
Age	0.018675***	0.018681***	0.018623***	0.018742***
	(0.006)	(0.006)	(0.006)	(0.006)
Age^2	-0.000153***	-0.000153***	-0.000153***	-0.000154***
	(0.000)	(0.000)	(0.000)	(0.000)
Household Size	0.057551***	0.056160***	0.056768***	0.056805***
	(0.007)	(0.007)	(0.007)	(0.007)
Population density	-0.000110*	-0.000114*	-0.000115*	-0.000116*
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall millimeters	-0.000000	-0.000001	-0.000002	-0.000002
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	0.524879	0.509925	0.514977	0.517439
	(0.355)	(0.357)	(0.359)	(0.359)
Long conflict exposure	0.115128	0.124515	0.129851	0.131794
	(0.235)	(0.236)	(0.236)	(0.237)
No.Market Infrastructure	0.018271**	0.017972*	0.017835*	0.017644*
	(0.009)	(0.009)	(0.009)	(0.009)
No.Social Infrastructure	0.002129	0.001533	0.001152	0.001134
	(0.006)	(0.006)	(0.006)	(0.006)
No.Health Infrastructure	-0.014522**	-0.014506**	-0.014439**	-0.014248**
	(0.006)	(0.006)	(0.006)	(0.006)
Land access/Household Size		-0.015852		
		(0.010)		
Real Land value in '000 ₦			-0.000001	
			(0.000)	
Real Land value in '000 ₦/Household size				0.000004
				(0.000)
R_2	0.198544	0.197088	0.196595	0.196621
N	6924	6924	6921	6921

Note: We also control for sector but estimates are insignificant and values negligible. We also do not display the estimate of the constant given the table length.We also included year fixed effects
Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 3: Land Access and Poverty (Balanced Panel 2010-2018)

	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty
Land access in Acres	-0.007838*			
	(0.004)			
Landless Dummy	0.004009	0.014427	0.019509	0.019795
	(0.045)	(0.045)	(0.045)	(0.045)
Years of Schooling	-0.001882	-0.001881	-0.001907	-0.001937
	(0.003)	(0.003)	(0.003)	(0.003)
Age	0.010374	0.010008	0.009988	0.010064
	(0.009)	(0.009)	(0.009)	(0.009)
Age^2	-0.000079	-0.000075	-0.000075	-0.000076
	(0.000)	(0.000)	(0.000)	(0.000)
Household Size	0.044572***	0.043702***	0.044185***	0.044160***
	(0.009)	(0.009)	(0.009)	(0.009)
Population density	-0.000066	-0.000061	-0.000058	-0.000061
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall in millimeters	0.000070**	0.000069**	0.000065**	0.000067**
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	1.562102***	1.548022***	1.541252***	1.541321***
	(0.474)	(0.473)	(0.474)	(0.473)
Long conflict exposure	-0.341449	-0.317979	-0.316026	-0.312254
	(0.260)	(0.259)	(0.260)	(0.260)
No.of Market Infrastructure	-0.013972	-0.013664	-0.014194	-0.013813
	(0.016)	(0.016)	(0.016)	(0.016)
No. of Social Infrastructure	0.015665	0.014957	0.014409	0.014438
	(0.010)	(0.010)	(0.010)	(0.010)
No. of Health Infrastructure	-0.011869	-0.012631	-0.012653	-0.012673
	(0.010)	(0.010)	(0.010)	(0.010)
Land access/Household Size		-0.015508		
		(0.018)		
Real Land value in '000 ₦			-0.000004	
			(0.000)	
Real Land value in '000 ₦/Household size				-0.000003
				(0.000)
R_2	0.160906	0.158876	0.158828	0.158515
N	2391	2391	2391	2391

Note: estimate of constant not shown given length of table. Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 4: Land Access and Poverty (Unbalanced Panel 2010-2018)

	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty
Land access in Acres	-0.006172***			
	(0.002)			
Landless Dummy	-0.034934	-0.030223	-0.024284	-0.024364
	(0.028)	(0.028)	(0.028)	(0.028)
Years of Schooling	-0.003176	-0.003188	-0.003245	-0.003255
	(0.002)	(0.002)	(0.002)	(0.002)
Age	0.019759***	0.019667***	0.019558***	0.019690***
	(0.005)	(0.005)	(0.005)	(0.005)
Age^2	-0.000167***	-0.000166***	-0.000165***	-0.000167***
	(0.000)	(0.000)	(0.000)	(0.000)
Household Size	0.047305***	0.046236***	0.046833***	0.046880***
	(0.006)	(0.006)	(0.006)	(0.006)
Population density	-0.000104*	-0.000106*	-0.000107*	-0.000107*
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall millimeters	0.000023	0.000023	0.000022	0.000022
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	0.564936*	0.547206*	0.548265*	0.551161*
	(0.330)	(0.331)	(0.333)	(0.332)
Long conflict exposure	0.080289	0.093378	0.099457	0.101833
	(0.206)	(0.206)	(0.206)	(0.207)
No.Market Infrastructure	0.019652**	0.019445**	0.019311**	0.019146**
	(0.009)	(0.009)	(0.009)	(0.009)
No.Social Infrastructure	0.003651	0.003194	0.002771	0.002813
	(0.006)	(0.006)	(0.006)	(0.006)
No.Health Infrastructure	-0.015301***	-0.015344***	-0.015300***	-0.015140***
	(0.006)	(0.006)	(0.006)	(0.006)
Land access/Household Size		-0.016503*		
		(0.010)		
Real Land value in ’000 ₦			-0.000001	
			(0.000)	
Real Land value in ’000 ₦/Household size				0.000003
				(0.000)
R_2	0.180843	0.179751	0.179261	0.179255
N	10276	10276	10273	10273

Note: estimate of constant not shown given length of table. Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 5: Land Access and Poverty- (Testing for nonlinearity in Land access Balanced Panel 2010-2015)

	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty
Land access in Acres	-0.007743**			
	(0.004)			
Land access in $Acres^2$	0.000036			
	(0.000)			
Landless Dummy	-0.069661**	-0.066092**	-0.056128*	-0.056717*
	(0.030)	(0.031)	(0.030)	(0.031)
Years of Schooling	-0.004837*	-0.004806*	-0.004888*	-0.004896*
	(0.003)	(0.003)	(0.003)	(0.003)
Age	0.018652***	0.018644***	0.018576***	0.018746***
	(0.006)	(0.006)	(0.006)	(0.006)
Age^2	-0.000153***	-0.000153***	-0.000153***	-0.000154***
	(0.000)	(0.000)	(0.000)	(0.000)
Household Size	0.057543***	0.055769***	0.056755***	0.056793***
	(0.007)	(0.007)	(0.007)	(0.007)
Population density	-0.000110*	-0.000112*	-0.000115*	-0.000116*
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall in millimeters	-0.000000	0.000000	-0.000002	-0.000002
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	0.526263	0.517505	0.512841	0.517237
	(0.355)	(0.356)	(0.359)	(0.359)
Long conflict exposure	0.114648	0.117872	0.126739	0.131717
	(0.235)	(0.235)	(0.235)	(0.237)
No.Market Infrastructure	0.018273**	0.017860*	0.017962*	0.017651*
	(0.009)	(0.009)	(0.009)	(0.009)
No.Social Infrastructure	0.002154	0.002010	0.001185	0.001139
	(0.006)	(0.006)	(0.006)	(0.006)
No.Health Infrastructure	-0.014495**	-0.014486**	-0.014365**	-0.014245**
	(0.006)	(0.006)	(0.006)	(0.006)
Land access/Household Size		-0.038344***		
		(0.013)		
Land access/Household $size^2$		0.001812***		
		(0.001)		
Real Land value in '000 ₦			-0.000004	
			(0.000)	
Real Land value^2 in '000 ₦			0.000000**	
			(0.000)	
Real Land value in '000 ₦/Household size				0.000003
				(0.000)
Real Land value /Household$size^2$ in '000 ₦				0.000000
				(0.000)
R_2	0.198558	0.197944	0.196846	0.196622
N	6924	6924	6921	6921

Note: We also control for year-fixed effects and sectors. Given length of the table we do not include the estimate of the constant. Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 6: Land Access and Poverty (Testing for nonlinearity in Land access balanced Panel 2010-2018)

	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty
Land access in Acres	-0.019582**			
	(0.009)			
Land access^2	0.000665			
	(0.000)			
Landless Dummy	-0.011961	0.004105	0.018854	0.019322
	(0.046)	(0.045)	(0.044)	(0.045)
Years of Schooling	-0.001490	-0.001825	-0.001886	-0.001913
	(0.003)	(0.003)	(0.003)	(0.003)
Age	0.010762	0.010546	0.009275	0.010143
	(0.009)	(0.009)	(0.009)	(0.009)
Age^2	-0.000082	-0.000080	-0.000069	-0.000077
	(0.000)	(0.000)	(0.000)	(0.000)
Household Size	0.044078***	0.042409***	0.044503***	0.043643***
	(0.009)	(0.009)	(0.009)	(0.009)
Population density	-0.000075	-0.000061	-0.000058	-0.000060
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall in millimeters	0.000069**	0.000068**	0.000068**	0.000066**
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	1.565566***	1.566090***	1.537509***	1.539963***
	(0.476)	(0.474)	(0.481)	(0.474)
Long conflict exposure	-0.350717	-0.335170	-0.317994	-0.315606
	(0.262)	(0.260)	(0.262)	(0.260)
No.of Market Infrastructure	-0.014603	-0.014572	-0.014007	-0.014074
	(0.016)	(0.016)	(0.016)	(0.016)
No.of Social Infrastructure	0.016909*	0.015413	0.014044	0.014523
	(0.010)	(0.010)	(0.010)	(0.010)
No.of Health Infrastructure	-0.011567	-0.011990	-0.012337	-0.012507
	(0.010)	(0.010)	(0.010)	(0.010)
Land access/Household Size		-0.059337*		
		(0.034)		
Land access/Household $size^2$		0.006689**		
		(0.003)		
Real Land value in '000 ₦			-0.000019**	
			(0.000)	
Real Land value^2 in '000 ₦			0.000000*	
			(0.000)	
Real Land value in '000 ₦/household size				-0.000028
				(0.000)
Real Land value /household $size^2$ in '000 ₦				0.000000*
				(0.000)
R_2	0.162531	0.160424	0.160157	0.158889
N	2391	2391	2391	2391

Note: Given the length of the table we do not show the constant estimate and estimates for time-fixed effects and sector. Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 7: Land Access and Poverty (Testing for nonlinearity in Land access Unbalanced Panel 2010-2018)

	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty
Land access in Acres	-0.008191**			
	(0.004)			
$Landaccess^2$	0.000085			
	(0.000)			
Landless Dummy	-0.037446	-0.034123	-0.024141	-0.024400
	(0.028)	(0.028)	(0.028)	(0.028)
Years of Schooling	-0.003146	-0.003149	-0.003238	-0.003250
	(0.002)	(0.002)	(0.002)	(0.002)
Age	0.019745***	0.019678***	0.019477***	0.019697***
	(0.005)	(0.005)	(0.005)	(0.005)
Age^2	-0.000167***	-0.000166***	-0.000165***	-0.000167***
	(0.000)	(0.000)	(0.000)	(0.000)
Household Size	0.047295***	0.045777***	0.046831***	0.046826***
	(0.006)	(0.006)	(0.006)	(0.006)
Population density	-0.000103*	-0.000105*	-0.000106*	-0.000107*
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall in millimeters	0.000023	0.000024	0.000021	0.000022
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	0.569376*	0.557870*	0.545079	0.550514*
	(0.329)	(0.330)	(0.333)	(0.332)
Long conflict exposure	0.077850	0.084610	0.095683	0.101313
	(0.206)	(0.206)	(0.206)	(0.207)
No. of Market Infrastructure	0.019667**	0.019378**	0.019408**	0.019160**
	(0.009)	(0.009)	(0.009)	(0.009)
No. of Social Infrastructure	0.003725	0.003633	0.002721	0.002807
	(0.006)	(0.006)	(0.006)	(0.006)
No. of Health Infrastructure	-0.015234***	-0.015304***	-0.015209***	-0.015123***
	(0.006)	(0.006)	(0.006)	(0.006)
Land access/Household Size		-0.038793***		
		(0.013)		
Land access/Household $size^2$		0.001878***		
		(0.001)		
Real Land value in '000 ₦			-0.000004*	
			(0.000)	
Real Land $value^2$ in '000 ₦			0.000000**	
			(0.000)	
Real Land value /Household size in '000 ₦				0.000000
				(0.000)
Real Land value /household $size^2$ in '000 ₦				0.000000
				(0.000)
Constant	-0.589489***	-0.580397***	-0.591461***	-0.593956***
	(0.160)	(0.160)	(0.161)	(0.161)
R_2	0.180920	0.180597	0.179567	0.179269
N	10276	10276	10273	10273

Table 8: Land Access and Poverty (LGA Level Fixed Effects Models)

	Unbalanced Panel(2010-2018)		Balanced Panel(2010-2015)	
	(1)	(2)	(3)	(4)
	Poverty	Poverty	Poverty	Poverty
Land access in Acres	-0.002596		-0.014443**	
	(0.005)		(0.006)	
Landless Dummy	-0.057979	-0.052142	-0.215579***	-0.188814***
	(0.050)	(0.049)	(0.061)	(0.062)
Years of Schooling	-0.012335***	-0.012264***	-0.009681	-0.007972
	(0.004)	(0.004)	(0.007)	(0.007)
Age	0.022896**	0.022483**	0.053965***	0.054105***
	(0.010)	(0.010)	(0.017)	(0.017)
Age^2	-0.000178*	-0.000174*	-0.000446***	-0.000454***
	(0.000)	(0.000)	(0.000)	(0.000)
Household size	0.033896***	0.033737***	0.079544***	0.081723***
	(0.009)	(0.009)	(0.020)	(0.021)
Population density	-0.000050	-0.000053	-0.000102*	-0.000122*
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall in millimeters	0.000030*	0.000029*	-0.000010	-0.000016
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	0.053550	0.047951	0.226996	0.172427
	(0.318)	(0.316)	(0.282)	(0.278)
Long conflict exposure	0.356643*	0.368234*	0.185514	0.259464**
	(0.197)	(0.194)	(0.116)	(0.114)
No.Market Infrastructure	0.021973**	0.022013**	0.031229***	0.028582***
	(0.009)	(0.009)	(0.010)	(0.010)
No. Social Infrastructure	0.000998	0.001004	0.000342	-0.000497
	(0.006)	(0.006)	(0.007)	(0.007)
No. Health Infrastructure	-0.009155*	-0.009143*	-0.006427	-0.005530
	(0.005)	(0.005)	(0.007)	(0.007)
Real Land value in '000 ₦		0.000001		0.000005
		(0.000)		(0.000)
R_2	0.456586	0.456309	0.587750	0.581200
N	1212	1212	718	718

Note: Estimates for constant not included in the table given length.
Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 9: Land Access and Poverty (LGA Level Analysis with test for nonlinearities in land access)

	Unbalanced Panel(2010-2018)		Balanced Panel(2010-2015)	
	(1)	(2)	(3)	(4)
	Poverty	Poverty	Poverty	Poverty
Land access in Acres	-0.001985		0.015691*	
	(0.006)		(0.009)	
Land access^2	-0.000027		-0.001554***	
	(0.000)		(0.000)	
Landless Dummy	-0.056841	-0.049430	-0.150910**	-0.188104***
	(0.051)	(0.049)	(0.061)	(0.062)
Years of Schooling	-0.012278***	-0.012190***	-0.008539	-0.008011
	(0.004)	(0.004)	(0.007)	(0.007)
Age	0.022919**	0.022688**	0.055072***	0.054441***
	(0.010)	(0.010)	(0.017)	(0.018)
Age^2	-0.000178*	-0.000176*	-0.000453***	-0.000457***
	(0.000)	(0.000)	(0.000)	(0.000)
Household size	0.033900***	0.032703***	0.089519***	0.082356***
	(0.009)	(0.009)	(0.019)	(0.021)
Population density	-0.000050	-0.000049	-0.000113*	-0.000121**
	(0.000)	(0.000)	(0.000)	(0.000)
Rainfall in millimeters	0.000030*	0.000028*	0.000000	-0.000016
	(0.000)	(0.000)	(0.000)	(0.000)
Recent conflict exposure	0.053109	0.048653	0.239208	0.172578
	(0.318)	(0.316)	(0.294)	(0.277)
Long conflict exposure	0.356988*	0.363528*	0.204771*	0.264684**
	(0.197)	(0.193)	(0.120)	(0.111)
No.Market Infrastructure	0.021915**	0.022036**	0.031020***	0.028926***
	(0.009)	(0.009)	(0.010)	(0.010)
No.Social Infrastructure	0.000942	0.001073	0.002136	-0.000390
	(0.006)	(0.006)	(0.007)	(0.007)
No.Health Infrastructure	-0.009149*	-0.009450*	-0.008521	-0.005930
	(0.005)	(0.005)	(0.007)	(0.007)
Real Land value in '000 ₦		-0.000002		0.000010
		(0.000)		(0.000)
Real Land value ^{2} in '000 ₦		0.000000		-0.000000
		(0.000)		(0.000)
Constant	-0.590364**	-0.583362**	-1.777430***	-1.659342***
	(0.271)	(0.272)	(0.451)	(0.476)
R^2	0.456602	0.457046	0.600232	0.581502
N	1212	1212	718	718

Estimates for constant not included in the table given length.
Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 10: Land Access and Poverty - CRE Analysis (Balanced Panel 2010-2015)

	(1)	(2)	(3)	(4)
	Poverty	Poverty	Poverty	Poverty
	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx
Land access in Acres	-0.008684***			
	(0.003)			
Landless Dummy	-0.073787**	-0.075745**	-0.060316	-0.063942*
	(0.035)	(0.035)	(0.036)	(0.036)
Land access/Household Size		-0.055798***		
		(0.018)		
Real Land value in '000 ₦			-0.000005	
			(0.000)	
Real Land value /Household size in '000 ₦				0.000010
				(0.000)
N	6924	6924	6921	6921

Note: In the table above we only display the land access variables. Each of the regressions also include a dummy for urban sector, years of Schooling, age, age squared, household size, population density, rainfall, recent conflict exposure, accumulated conflict exposure, market infrastructure, social infrastructure, health infrastructure, household-level time averages variables, time-year dummies, zonal level dummies, and zone-year interaction variables, averages for all time varying variables are also included in each regression but not displayed. We also do not display the estimate of the constant given the table length.
Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 11: Land size and Poverty -CRE Analysis (Unbalanced Panel 2010-2018)

	(1)	(2)	(3)	(4)
	Poverty	Poverty	Poverty	Poverty
	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx
Land access in Acres	-0.007025***			
	(0.003)			
Landless Dummy	-0.086607***	-0.087271***	-0.071709**	-0.074297**
	(0.031)	(0.031)	(0.031)	(0.031)
Land access/Household Size		-0.046639***		
		(0.016)		
Real Land value in '000 ₦			-0.000005	
			(0.000)	
Real Land value /Household size in '000 ₦				0.000001
				(0.000)
N	10276	10276	10273	10273

Note: In the table above we only display the land access variables. Each of the regressions also include a dummy for urban sector, years of Schooling, age, age squared, household size, population density, rainfall, recent conflict exposure, accumulated conflict exposure, market infrastructure, social infrastructure, health infrastructure, household-level time averages variables, time-year dummies, zonal level dummies, and zone-year interaction variables, averages for all time varying variables are also included in each regression but not displayed. We also do not display the estimate of the constant given the table length.
Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 12: Land Access and Poverty - CRE Analysis testing for nonlinearity in land access (Balanced Panel 2010-2015)

	(1)	(2)	(3)	(4)
	Poverty	Poverty	Poverty	Poverty
	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx
Land access in Acres	-0.008542*			
	(0.005)			
$Landaccess^2$	-0.000005			
	(0.000)			
Landless Dummy	-0.073680**	-0.076727**	-0.060681	-0.064416*
	(0.035)	(0.035)	(0.036)	(0.036)
Land access/Household Size		-0.067519**		
		(0.034)		
Land access/Household size^2		0.002140		
		(0.008)		
Real Land value in '000 ₦			-0.000008	
			(0.000)	
Real Land value ^{2} in '000 ₦			0.000000***	
			(0.000)	
Real Land value /Household size in '000 ₦				0.000000
				(0.000)
Real Land value /Household size^2 in '000 ₦				0.000000*
				(0.000)
N	6924	6924	6921	6921

Note: In the table above we only display the land access variables. Each of the regressions also include a dummy for urban sector, years of Schooling, age, age squared, household size, population density, rainfall, recent conflict exposure, accumulated conflict exposure, market infrastructure, social infrastructure, health infrastructure, household-level time averages variables, time-year dummies, zonal level dummies, and zone-year interaction variables, averages for all time varying variables are also included in each regression but not displayed. We also do not display the estimate of the constant given the table length.
Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Table 13: Land Access and Poverty - CRE Analysis testing for nonlinearity in land access (Unbalanced Panel 2010-2018)

	(1)	(2)	(3)	(4)
	Poverty	Poverty	Poverty	Poverty
	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx	dfdx/se_dfdx
Land access in Acres	-0.009630**			
	(0.005)			
$Landaccess^2$	0.000118			
	(0.000)			
Landless Dummy	-0.088427***	-0.089333***	-0.072181**	-0.074400**
	(0.031)	(0.031)	(0.031)	(0.031)
Land access/Household Size		-0.058318***		
		(0.019)		
Land access/Household size^2		0.002110***		
		(0.001)		
Real Land value in '000 ₦			-0.000009	
			(0.000)	
Real Land value ^{2} in '000 ₦			0.000000**	
			(0.000)	
Real Land value /Household size in '000 ₦				-0.000013
				(0.000)
Real Land value /Household size^2 in '000 ₦				0.000000**
				(0.000)
N	10276	10276	10273	10273

Note: In the table above we only display the land access variables. Each of the regressions also include a dummy for urban sector, years of Schooling, age, age squared, household size, population density, rainfall, recent conflict exposure, accumulated conflict exposure, market infrastructure, social infrastructure, health infrastructure, household-level time averages variables, time-year dummies, zonal level dummies, and zone-year interaction variables, averages for all time varying variables are also included in each regression but not displayed. We also do not display the estimate of the constant given the table length.
Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1

References

[1] Battese, G. (1997). A note on the estimation of Cobb-Douglas production functions when some explanatory variables have zero values. Journal of Agricultural Economics 48(1–3): 250–252.

[2] Barrett, Christopher B., Marc F. Bellemare, Janet Y. Hou, (2010) Reconsidering Conventional Explanations of the Inverse Productivity–Size Relationship, World Development, Volume 38, Issue 1, 2010, Pages 88-97,

[3] Bigsten, A., Kebede, B., Shimeles, A., and Taddesse, M., 2003. Growth and poverty reduction in Ethiopia: evidence from household panel surveys. World Development, 31 (1), 87–106.

[4] Binswanger, H.P., and K. Deininger. 1997. "Explaining Agricultural and Agrarian Policies in Developing Countries." Journal of Economic Literature 35:1958–2005.

[5] Barrett, C. B., Carter, M. R. and Little, P. D., 2006. Understanding and reducing persistent poverty in Africa: Introduction to a special issue. The Journal of Development Studies, 42(2): 167-177.

[6] Besley, T. and Burgess, R., 2000. Land reform, poverty reduction, and growth: Evidence from India. Quarterly Journal of Economics, 115: 389-430.

[7] Baulch, B. and Hoddinott, J., 2000. Economic mobility and poverty dynamics in developing countries. The Journal of Development Studies, 36(6): 1-24

[8] Binswanger, Hans, Deininger, Klaus, Feder, Gershon, 1995. Power, distortions, revolt, and reform in agricultural land relations. In: Behrman, J., Srinivasan, T.N. (Eds.) Handbook of Development Economics, vol. 3B. North-Holland, Amsterdam.

[9] Burgess, R., 2001. Land and welfare: theory and evidence from China. London: Department of Economics and STICERD (The Suntory and Toyota International Centres for Economics and Related Disciplines), London School of Economics Working Paper.

[10] Carte, M.R. and Mesbah, D. 1993 Can Land Market Reform Mitigate the Exclusionary Aspects of Rapid Agro-Export Growth? World Development, Vol. 21, No. 7, pp. 1085-1100. 1993.

[11] Carter, Michael, May, Julian, 1999. Poverty, livelihood, and class in rural South Africa. World Development 27 (7), 1 –20

[12] Carter, Michael (1984) Identification of The Inverse Relationship Between Farm Size and Productivity: An Empirical Analysis of Peasant Agricultural Production Oxford Economic Papers, Volume 36, Issue March 1984, Pages 131–145, https://doi.org/10.1093/oxfordjournals.oep.a041621

[13] Carter, M. R., and Olinto, P., 2003. Getting institutions "right" for whom? Credit constraints and the impact of property rights on the quantity and composition of investment. American Journal of Agricultural Economics, 85(1): 173-186

[14] Cipollina, M., Cuffaro, N. and Giovanna, D., 2018. Land inequality and economic growth: Ameta-analysis. Sustainability, 10(4655), doi:10.3390/su10124655.

[15] Chamberlin and Ricker-Gilbert (2016) Participation in Rural Land Rental Markets in Sub-Saharan Africa: Who Benefits and By How Much? Evidence From Malawi and Zambia. American Journal of Agricultural Economics Advance Access published May 21, 2016

[16] Chamberlin, Jordan and Jayne, T.S. (2019) Does farm structure affect rural household incomes? Evidence from Tanzania. Food Policy, https://doi.org/10.1016/j.foodpol.2019.101805

[17] Deininger, K., and L. Squire. 1998. "New Ways of Looking at Old Issues: Inequality and Growth." Journal of Development Economics 57:259–87.

[18] Dorner, Peter, 1992. Latin American land reforms in theory and practice: a retrospective analysis. The University of Wisconsin Press, Madison, Wisconsin.

[19] Easterly, W. and Kraay, A. (2000). Small states, small problems? Income, growth, and volatility in small states. World Development 28(11): 2013–2027.

[20] Ellis, F. and Bahiigwa, G., 2003. Livelihoods and rural poverty reduction in Uganda. World Development, 31 (6), 997–1013.

[21] Ellis, F. and Mdoe, N., 2003. Livelihoods and rural poverty reduction in Tanzania. World Development, 31 (8), 1367–1384.

[22] Etowa, E.B.and Nwiido, E.D(2019) Linking Land Use Choice with Land Access in Nigerian Agrarian Communities. Journal of Land and Rural Studies 7(1) 23–38, 2019

[23] FAO.[FAOSTAT: LAND USE]. License: CC BY-NC-SA 3.0 IGO. Extracted from: https://www.fao.org/faostat/en/#data/RLinsertURLofdatabase].DateofAccess:[29-12-2023]

[24] Feder, G. 1985. "The Relation Between Farm Size and Farm Productivity." Journal of Development Economics 18:297–313.

[25] Finan, F., Sadoulet, E. and de Janvry, A.2005 Measuring the poverty reduction potential of land in rural Mexico. Journal of Development Economics 77 (2005) 27– 51

[26] Frisvold, G.B. 1994. "Does Supervision Matter? Some Hypothesis Tests Using Indian Farm Level Data." Journal of Development Economics 43:217–38.

[27] Ghebru, H. and Girmachew,F. (2017) Scrutinizing the status quo: Rural transformation and land tenure security in Nigeria.IFPRI Working Paper 43, Strategy to support Program

[28] Ghebru, H., and A. Okumo. 2016. Land Administration Service Delivery and Its Challenges in Nigeria. IFPRI-NSSP Working Paper 39. Abuja, Nigeria: International Food Policy Research Institute.

[29] Ghebru, H., H. Edeh, D. Ali, K. Deininger, A. Okumo, and S. Woldeyohannes. 2014. Tenure Security and Demand for Land Tenure Regularization in Nigeria. Nigeria Strategy Support Program (NSSP) Working Paper 25. Abuja: International Food Policy Research Institute.

[30] Griffin, K., Khan, A. R., and Ickowitz, A., 2002. Poverty and the distribution of land. Journal of Agrarian Change, 2: 279-330

[31] Grootaert C., Kanbur, R., Gi-taik, O., 1997. The Dynamic of Welfare Gain and Losses: An African Case Study. Journal of Development Studies, 33, 635-657.

[32] Gunning, J. W., Hoddinott, J., Bill, K., Trudy, O., 2000. Revisiting Forever Gained: Income Dynamics in the Resettlement Areas of Zimbabwe, 1983-96. Journal of Development Studies, 36, 131-154.

[33] Heltberg, R. 1998. "Rural Market Imperfections and the Farm Size-Productivity Relationship: Evidence from Pakistan." World Development 26:1807–26.

[34] Jayne, T. S., Yamano, T., Weber, T., Tschirley, D., Benfica, R., Chapoto, A. and Zulu, B. (2003). Smallholder income and land distribution in Africa: implications for poverty reduction strategies. Food Policy 28: 253–275.

[35] Kinsey, B., 1999. Land reform, growth, and equity: emerging evidence from Zimbabwe's resettlement program. Journal of Southern African Studies, 25 (2), 173–196.

[36] Lóapez, R. and Valdés, A.(2000)Fighting Rural Poverty in Latin America: New Evidence of the Effects of Education, Demographics, and Access to Land. Economic Development and Cultural Change, Vol. 49, No. 1 (October 2000), pp. 197-211

[37] McCulloch, N. and Baulch, B. (2000). Simulating the impact of policy upon chronic and transitory poverty in rural Pakistan. Journal of Development Studies 36(6): 100–130.

[38] National Agricultural Extension and Research Liaison Services (NAERLS)/Federal Ministry of Agricultural and Rural Development(FMARD) 2021. Annual Agricultural Performance Survey Report of Nigeria: 2021 Wet Season. NAERLS Press.

[39] National Bureau of Statistics (NBS) . (2019). General Household Survey, Panel 2018-2019, Wave 4 [Data set]. World Bank, Development Data Group.

[40] National Bureau of Statistics (NBS) . (2016). General Household Survey, Panel 2015-2016, Wave 3 [Data set]. World Bank, Development Data Group.

[41] National Bureau of Statistics (NBS) . (2014). General Household Survey, Panel 2012-2013, Wave 2 [Data set]. World Bank, Development Data Group.

[42] National Bureau of Statistics . (2012). General Household Survey, Panel 2010-2011, Wave 1 [Data set]. World Bank, Development Data Group.

[43] Olomola, A. (2013) Policy options for agricultural investments and governance of markets. In support of small-scale agriculture in Nigeria. Oxfam Research Reports

[44] Odozi, J. C., & Oyelere, R. U. (2021). Does violent conflict affect the labor supply of farm households? The Nigerian experience. Agricultural and Resource Economics Review, 50(3), 401-435.

[45] Odozi, J. C., & Oyelere, R. U. (2022). Violent Conflict Exposure in Nigeria and Household Welfare: What Can We Learn from Panel Data?.

[46] Ravallion, M. and van de Walle, D. (2008). Land in Transition: Reform and Poverty in Rural Vietnam. Washington, DC: World Bank and Palgrave Macmillan Press.

[47] Scott C. D., 2000. Mixed Fortunes: A Study of Poverty Mobility among Small Farms Households in Chile, 1968-86. Journal of Development Studies, 36, 155-180.

[48] Sheahan, M., Barrett, C.B. Ten striking facts about agricultural input use in Sub-Saharan Africa. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.09.010

[49] Thiesenheusen, William, 1989. Searching for agrarian reform in Latin America. Unwin Hyman, Boston.

[50] Tran, T.Q. and Vu, H.V(2019)Land fragmentation and household income: First evidence from rural Vietnam. Land Use Policy 89 (2019) 104247https://doi.org/10.1016/j.landusepol.2019.104247

[51] Ukaejiofo, A.N., and I.S. Nnaemeka. 2014. "The Dilemma of Restructuring the Land Governance System in Nigeria." Paper presented at FIG Congress: Engaging the Challenge- Enhancing the Relevance, Kuala Lumpur, Malaysia, June 16-21.

[52] Vendryes, T., 2014. Peasants against private property rights: a review of the literature. J. Econ. Surv. 28 (5), 971–995.

[53] Vollrath, Dietrich (2007). Land distribution and international productivity Amer. J. Agr. Econ. 89(1) (February 2007): 202–216

[54] Warriner, Doreen, 1969. Land reform in principle and practice. Clarendon Press, Oxford

[55] Winters, L. A., McCulloch, N. and McKay, A. (2004). Trade liberalization and poverty: the evidence so far. Journal of Economic Literature 42: 72–115.

[56] Wooldridge, J. M. (2019). Correlated random effects models with unbalanced panels. Journal of Econometrics, 211(1), 137-150.

[57] World Bank Data Base: Population portal Extracted from https://data.worldbank.org/indicator/SP.POP.TOTL?locations=NG. Date of access: 29-12-2023