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Land Tenure and Property Rights, and Food Security among Farm Households in Nigeria

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Abstract

This study examines the Land Tenure and Property Rights (LTPRs) enjoyed on farmlands of smallholder farmers in Nigeria, and the effects on Household Food Security (HFS). The study was based on data obtained in a cross-section survey of 1,536 farm households drawn by multistage random sampling across the six geopolitical zone of the country. LTPRs was assessed in terms of tenure type and land titling (*dejure* security); while HFS was assessed in terms of per caput calorie intake and household dietary diversity score (HDDS), categorized as either low, medium or high. Descriptive and econometric data analysis within the framework of binary logit and poisson regression model. The results showed that majority of farm land were either acquired through inheritance (53.5%) or leased (20.3%), with only 2.9% of the land title registered with the State government. Poisson regression result shows that HDDs is positively and significantly enhanced among farm households that were able to acquire more land through lease ($p<0.01$) or communal arrangement ($p<0.05$), but is not significantly influenced by land titling. The evidence thus supports policy development of local markets that make land available to farmers through lease and communal arrangement.

KEYWORDS: household dietary diversity; household food security; land tenure and property rights; poisson regression model; Nigeria

Introduction

Land Tenure and Property Rights (LTPRs) – *referring to the rights that individuals, communities, families, firms, and other community structures hold in land and associated natural resources* – are increasingly linked to livelihood and development outcomes. The rights are, however, said to be secure if the land users will not be arbitrarily deprived of the rights they enjoyed over the land and the economic benefits that flow from it [United Nations Human Settlements Programme (UN-HABITAT), 2003].

Land plays an essential role in the livelihoods of most Africans including Nigerians, food security and poverty reduction cannot be accomplished except the subject of access to land, security of tenure and the capacity to use land productively and in a sustainable manner are addressed [Economic Commission for Africa (ECA), 2004]. Evidence in the literature (World Bank, 2011; FAO, 2010) suggest that both statutory and customary tenure systems are under stress in the face of global demographic growth, growing food scarcity, and environmental degradation of land, fisheries, and forest resources—compounded by the forces of global climate change.

Access to land and security of tenure are the main means through which food security can be realized in Africa, Nigeria inclusive (Ariana, 2014). Food security is said to exist at the individual, household, national, regional, and global levels when all people, always, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for a healthy and active life (World Food Summit, 1996). Research has shown that the livelihoods of over 70% of the population in Africa are mainly linked to land and natural resources exploitation (ECA, 2004). A large proportion of the smallholder farmers, however, lack adequate access to quality land, and when they do have access, they have limited rights to it (Roth, 2013) as they might be able to cultivate the land but not being able to use it as collateral, rent it, sell it, or hold the land for a long enough period to recoup labour and capital investments.

Having unrestricted access to and managing land in a sustainable manner are the key factors to enable smallholder farmers to exercise their fundamental right to be free from hunger and poverty [International Land Coalition (ILC), 2010]. Evidence from literature (FAO, 1995; Landesa, 2012) show that securing land rights for smallholder farmers has several important positive benefits for household food security. Even though, Netherlands Academy on Land Governance (LANDac, 2017) suggests that securing land rights is the first step towards better

food security, it is not the ultimate solution. Food security for rural farming households is not just a question of access to and control over land, it also depends on other factors such as improved agricultural technology, availability of labour, production diversity among other things (Tanner, 2013).

Arising from the foregoing, this study focusses on the influence of LTPRs on household food security. Household food security is measured using per caput recommended daily calorie intake of 2100 kcal and household dietary diversity score (HDDS). Labadarios *et al*., (2011) established that no single food item can contain all nutrients, the more the food groups included in the daily diet the greater the likelihood of meeting nutrient requirements. Hence, diverse food can serve as the proxy to measure the consumption quality and describe food access in the context of food security since diverse diet can sufficiently reflect nutrient adequacy (Hoddinott, 2002; Drimie *et al*., 2013).

Specifically, this study attempt to provide answers to the following research questions:

Is there any relationship between per caput recommended daily calorie intake and household dietary diversity?

Do land tenure and property rights among other socio-economic factors influence food security?

A search in literature shows that several studies have focused on the determinants of food security in Nigeria over the years. Some of the studies from Nigeria include Babatunde *et al*., (2007); Omotesho *et al*., (2009); Beyene and Muche, (2010); Olagunju *et al*., (2012); Ahmed *et al*., (2015) among others. Some of the indicators used by these studies range from self-report/assessment, cost of calorie, two-thirds of per capita food expenditure to anthropometric measure. This study unlike many other studies in Nigeria employed HDDS and per capita daily calorie intake to determine food utilization and accessibility. It also uses nationally representative household survey that cut across all the geopolitical zones in the country, as this is likely to provide national estimates that are more crucial for policy making since individual-level estimates demonstrated in the previous studies are not ensued at the national level.

The paper is structured as follows: the theoretical framework is discussed next, the variable measurement, followed by the methodology and analytical technique on the influence of LTPRs among other socio-economic factors on households' food security, in this order. This is followed by the results and discussion section. Finally, conclusions are drawn based on the findings of the study.

2. Theoretical Framework

The theoretical framework for modelling the determinants of household food security is built within the framework of the farm household utility model. Following Singh *et al*., (1986), farm households produce partly for sale and partly for their own consumption and therefore, model household utility within the framework of consumer demand and production theories as follows:

$$U_i = u(C_i, le_i \mid X_i) \quad (1)$$

where U_i is a utility function that is twice differentiable, monotonically increasing function of consumption, C_i, and leisure, le_i, and strictly quasi-concave; C_i is a vector of the i^{th} farm household's consumption demand, le_i is the time devoted to leisure and X_i is the vector of preference shifters which might include household socio-demographic variables or things that affect its preference for leisure over-consumption. C_i can be further considered as a vector of home-produced food, F_H and market-purchased food, F_M. Again, within this context, C_i can be stated as follows:

$$C_i = (F_H, F_P) \quad (2)$$

Substituting Eq. 2 into Eq. 1 gives Becker's (1981) generalized utility function defined as:

$$U_i = u[(F_H, F_P), le_i \mid X_i] \quad (3)$$

For those households that produce food which they also consume and that are consequently subject to certain constraints of production, income and time factors, the optimization of Eq. 3 requires that household's production decisions are made independently of consumption decisions on the assumption that they are all relevant to the market. Ogundari (2017) argued that production decisions are first made and then subsequently used in allocating the income between consumption of goods and leisure. In the same vein, Feleke *et al*., (2005) opined that it is important to make this assumption because food security or food consumption often depends on production variables, but not vice versa.

Following Singh *et al*., (1986), the production, income, and time constraints imposed in the course of optimizing Eq. 3 are specified as follows:

Production constraint

$$f(Q_H, L, A^o, K^o) = 0 \quad (4)$$

Equation 4 is a typical household production function for food Q_H produced at home and assumed to be twice differentiable, increasing in outputs, decreasing in inputs, and strictly convex; A^o is the farm size; K^o is the fixed capital stock; L is total labour used on the farm.

Income constraint

$$P_H(Q_H - F_H) - P_M F_M - w(L - l_f) + N = 0 \; f(Q^H, L, A^o, K^o) = 0 \qquad (5)$$

From Eq. 5, P_H is the price of food produced, $Q_H - F_H$ is the marketed surplus of food produced; w is the wage rate; l_f is the total family labour supply on the farm; P_M is the price per unit of market-purchased food items; w is the wage for hired labour; N is the non-farm income adjusted to ensure that Eq. 5 equal to zero.

The farm household also faces a time constraint as it cannot allocate more time to on or off-farm activities as well as leisure than the total time available to the household.

$$T = l_f + le \qquad (6)$$

$$l_f = T - le \qquad (7)$$

where T is household's time stock received in each time period, which is allocated between leisure le and time spent working on the farm l_f. Substituting the right-hand side (RHS) of Eq. 7 into 5 gives:

$$P_H(Q_H - F_H) - P_M F_M - w(L - T + le) + N = 0 \qquad (8)$$

Expanding Eq. 8 gives:

$$P_H Q_H - P_H F_H - P_M F_M - wL + wT + wle + N = 0 \qquad (9)$$

Re-arranging Eq. 9 to explicitly account for household income and expenditure gives:

$$P_H Q_H + wT + N - wL = P_H F_H + P_M F_M + wle = 0 \qquad (10)$$

Equation 10 shows that the left-hand side (LHS) equals household income. The household income comprises the value of farm produce $P_H Q_H$, value of HH's time stock wT, the value of labour used wl, and non-farm income N.

Likewise, the RHS is equivalent to household expenditure. Hence, the household expenditure includes the value of home produce food consumed $P_H F_H$, the value of market purchase food consumed $P_M F_M$, and purchase of leisure wle. The optimization of Eq. 3 gives rise to income and expenditure equation within the separability assumption, which is necessary to have first order conditions. It is also possible through optimization of Eq. 10 to yield production and consumption equations separately. This is discussed as follows:

The demand for inputs and output produced, especially for households that produced their food at home, can be derived by maximizing the first-order condition of the LHS of Eq. 10 with respect to labour (L) and output produced (Q) as:

$$L^* = le^*(P_H, w, A^o, K^o) \quad (11)$$

$$Q^* = Q^*{}_H(P_H, w, A^o, K^o) \quad (12)$$

where L^* is the optimum labour used and Q^* is the optimum output. Substituting Eq. 11 and 12 into LHS of Eq. 10 gives optimum income Y* under the assumption of maximized profit π* as:

$$Y^* = P_H Q^* + wT + N - wL \quad (13)$$

$$Y^* = wT + \prod^*(P_H, w, A^o, K^o) + N \quad (14)$$

$$\prod^*(P_H, w, A^o, K^o) = P_H Q^* - wL \quad (15)$$

Household's demand for food C_i can be derived by solving the first-order conditions of the RHS of Eq. 10. However, recall in Eq. 2 that C_i is a vector of F_H and F_M which, in turn, depend on their respective prices. This relationship can be specified as:

$$C_i = c_i(F_H, F_M, w, Y^*) \quad (16)$$

Household demand for food also depends on the preferences of its members. These preferences are represented by household demographic characteristics in Eq. 16. Thus, in line with Eq. 14, we can further specify Y^* in Eq. 16 as:

$$C_i = c_i(F_H, F_P, w, Y^*(F_H, w, A^o, K^o, N) \mid x) \quad (17)$$

Equation 17 suggests that household food consumption C_i depends on food prices, wages, and household income. Thus, if household demand for food could be referred to as a measure of household food security (HFS), then C_i is a reduced form of the utility function in Eq. 1. It allows the evaluation of the effects of household level characteristics as well as economic factors such as income. The relationship can be represented by:

$$Ci \approx HFS_i = [F_{\exp}, N_{\text{int}\,ake}, P_{capita}, DDS, DDI, ..., etc] \quad (18)$$

where HFS is taken as a vector of various indicators of household food security, which could be food expenditure, nutrient intake such as calorie, protein and other food nutrients, dietary diversity score DDS, dietary diversity index, among others (Lokosang *et al*., 2011; Obayelu 2013; Pangaribowo *et al*., 2013, Ogundari, 2017).

3. Measurement of Variables

This section summarises the approaches used to measure the household's food security status and land tenure and property rights of farming households in Nigeria: per capita recommended daily calorie intake of 2100 kcal per adult per day, household dietary diversity score, and the land tenure and property rights.

3.1 Household Dietary Diversity Score

The Household Dietary Diversity Score (HDDS) is an indicator developed by the Food and Nutrition Technical Assistance Project (FANTA) that captures the quantity and, to an extent, quality of household food consumption (Swindale and Bilinsky, 2006). HDDS is meant to provide in summary the degree of household economic access to consume a wide range of foods. Following Swindale and Bilinsky (2006), dietary diversity scores were created by counting the food groups consumed by a household over a certain period of time usually ranges from one to three days, but seven days is also often used (FAO, 2011), and periods of up to 15 days have been reported (Drewnowski *et al*., 1997; Ruel, 2002). We use seven days' recall data collected from the household for this survey. The following set of 12 food groups is used to calculate the HDDS: Cereals, White tubers and roots, Vegetables[1], Fruits[2], Meat[3], Eggs, Fish and other seafood, Legumes, nuts and seeds, Milk and milk products, Oils and fats, Sweets, and Miscellaneous (Spices, condiments and beverages). We collected data for the HDDS indicator by asking the respondent[4] a series of yes or no questions with respect to the food groups consumed by the household members in the home or prepared in the home for consumption by household members outside the home during the last seven days. For a "YES" response, one point is awarded, otherwise, we awarded zero points. Values for the dietary diversity variable were later computed by adding all the 12 food groups included in the dietary diversity score for each household, therefore, making all scores to be within the range of 0-12. We categorised HDDS derived from the 12 food groups into three terciles: low (0 – 3), medium (4 - 6) and high (7 -12) dietary diversity groups.

[1] The vegetable food group is a combination of vitamin A rich vegetables and tubers, dark green leafy vegetables and other vegetables.
[2] The fruit group is a combination of vitamin A rich fruits and other fruits.
[3] The meat group is a combination of organ meat and flesh meat.
[4] This is the person responsible for food preparation in the household in the last seven days.

3.2 Daily Calorie Intake

Quantities of daily food intake were collected from each household, using a 7-days recall method. Though, there was no direct weighing of food quantities, a standard unit of measurement for each food item consumed by each household as well as the equivalent weight of that unit of measurement in kilogram was collected for each community. These physical measures were taken as the unit of measurement on the field for each community. Food price data were obtained through community market surveys. The quantities of food consumed by the households was converted into kilocalories using the nationally standardized food composition table manual, this was later divided into seven as a way of converting to daily calorie intake. The converted data were divided by household Adult Equivalent[5] to get per capita daily calorie intake. Food security thresholds defined by FAO (2100/day/person (FAO, 2007) was used. A household was considered as food secure whose daily per capita calorie intake was equal to or greater than the threshold while household that consumes below this minimum requirement was categorised as food insecure.

The per caput daily calorie intake level N_i was computed using equation 19:

$$N_i = \sum_{j=1}^{m} a_i Q_j \qquad (19)$$

Where:

N_i = Per caput daily calorie intake in kcal; a_i = standard measure of calorie found in each type of food item j consumed by each household; Q_j = weight in grams of the average daily intake of food item j by each household; where $Q_j = \frac{E_j}{P_i}$; E_j = Expenditure on food item j consumed by each household in naira; P_i = Unit Price per gram of food nutrient i

A total of 59 food items that were considered common food items in the area constituted our basket of food[6]. (i.e., $m = 59$).

[5] Adult-equivalent conversion factors for estimated calorie requirements according to age and gender (Levy *et al*., 2010)

[6] The food items include Baby milk, Beef/Suya/Dried meat, Beer, Bread, Bush meats, Cassava flour/Elubo, Cocoa based drinks, Cocoyam, Coffee, Cow skin, Cowpea, Crayfish & Crabs, Custard/Oats, Dried fish, Eggs, Fresh fish, Frozen fish/Smoked fish, Fruit juice, Fufu, Garri/Eba, Goat/Sheep meat, Groundnut, Kunnu, Leafy vegetables, Liquid milk (tin), Maize flour/Tuwo, Maize/Millet/Sorghum, Malt drinks, Mangoes, Melon, Noodles, Oranges, Other meats, Palm oil, Palm wine, Pawpaw, Pepper, Pineapple, Pito, Plantain flour, Plantain/Banana, Pork, Potatoes, Poultry meats, Powdered milk, Rice, Semovita/Semolina, Snails, Sobo juice, Soft drinks, Soybean/Other legume, Sphaghetti, Tea, Tomatoes, Vegetable oil, Water melon, Wheat/Wheat flour, Yam flour, Yam/Pounded yam.

3.3 Land Tenure and Property Rights

Two indicators were employed in assessing Land Tenure and Property Rights (LTPRs) of farmers in this study. They include:

Tenure Type: This refers to the mode of land acquisition which was measured on a nominal scale, using four dummy variables – Inherited, Purchased, Leasehold, and Communal. Each of these takes the value of one (1) if the right to use the parcel of land was acquired through inheritance, purchase, leased or rented for leasehold, and joint ownership with extended family or other community members for communal land use. Otherwise, the dummy variables were assigned a value zero (0).

Tenure security (legal): A tenure was classified as *de jure* secure if the parcel has been surveyed and duly registered with the land registry; otherwise it was classified as insecure. This variable was meant to determine the importance of title registration.

4. METHODOLOGY

4.1 Study Area

The study was conducted in selected farming communities reputed for maize and rice production across the six geopolitical zones, and covering five of the seven Agro-ecological zones (AEZs) of Nigeria (Figure 1). Nigeria is situated in the West African region and lies between longitudes $3^{\circ}$and 14° and latitudes 4° and 14°. It has a land mass of 923,768 sq.km. Nigeria shares a land border with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north. Its coast lies on the Gulf of Guinea in the south and it borders Lake Chad to the northeast (Udo *et al*., 2018).

Administratively, it is made of 36 Federating States and the Federal Capital Territory (FCT). The States are commonly grouped into six (6) geopolitical zones: Northeast, Northwest, North-central, Southeast, Southwest and South-south geopolitical zones. Nigeria is covered by three types of vegetation: forests (where there is significant tree cover), savannahs (insignificant tree cover, with grasses and flowers located between trees), and montane land; and is commonly divided into seven Agro-ecological zones; namely the Sahel Savannah, the Sudan Savannah and the Northern as well as Sothern Guinea Savannahs. Others AEZs include the Derived Savannah, the Mid-Altitude and the Humid Rainforests, all of which are suitable for maize and rice, among several other crops like cassava, yams, etc.

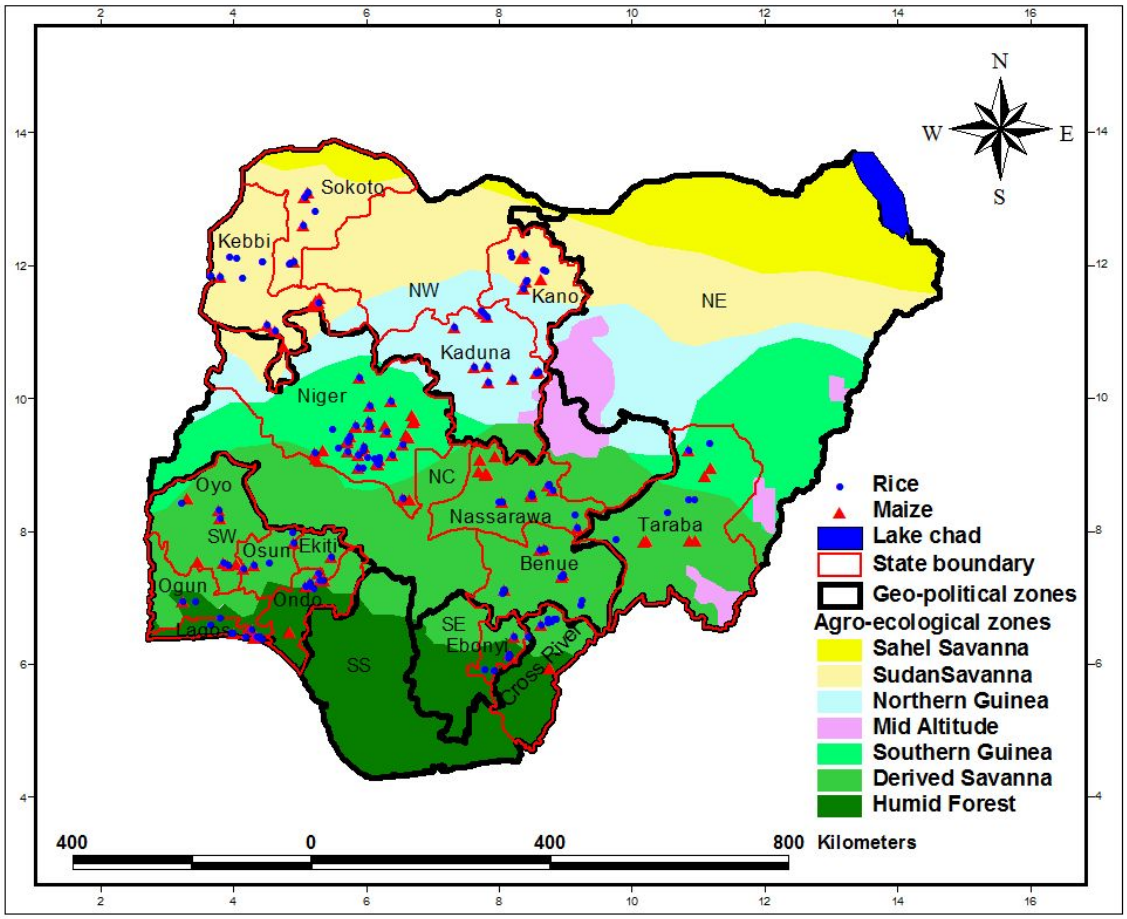

Figure 1: Map of Nigeria showing the study locations across the agro-ecological and geopolitical zones

4.2 Research Design

In this analysis, we make use of the 2017 the Federal University of Agriculture, Abeokuta (FUNAAB) ECOWAS RAAF PASANAO[7] Survey, a Nation-wide Survey of Cereals Production Systems and Willingness to Accept Incentives to Adopt Climate Smart Practices among Smallholders in Nigeria. This survey provides information on food items that were consumed at home by members of each household within the last 7 days and each parcel of land cultivated by household members within the last cropping season, which we use to infer the effects of land tenure and property rights on household food security. The 31-page farm household questionnaire contained six sections covering community characteristics, household information, production resource use, costs and outputs, environmental impacts awareness and mitigation strategies, land use choices and ecosystem service valuation, and household welfare

[7] Economic Community of West African States (ECOWAS) Regional Agency on Agriculture and Food (RAAF) Programme for Food and Nutrition Security in West Africa (PASANAO)

and livelihood outcomes. The fieldwork was implemented over three months, between January 2017 and April 2017. The survey was conducted by FUNAAB in partnership with the National Cereals Research Institute (NCRI), Badeggi, in combined efforts to provide evidence-based recommendations in support of agricultural development programming and policy formulation in Nigeria.

The three-stage sampling design was adopted:

Stage I: Purposive selection of 16 States (Fig. 1) that have been the leading rice and/ or maize producers in Nigeria (excluding conflict-prone areas), based on production statistics from [National Bureau of Statistics (NBS), 2016].

Stage II: Purposive selection of three (3) Agricultural Blocks per State per crop from the main rice and maize producing areas of the State, and two (2) Extension Cells per block - that is, six (6) blocks per state, 12 Cells per State and 192 Cells in all.

Stage III: Proportionate stratified random selection of eight (8) Rice and maize farmers from members of Rice/Maize farmers' association in each of the selected Cells.

This design yielded a total sample of 1,536 households but only 1,459 households supplied complete information.

5. Analytical Framework

Poisson Regression Model

Poisson regression model aims at analysing the influence of LTPRs among other socio-economic factors on dietary diversity score of rural household in Nigeria. The household dietary diversity score is a count variable, i.e., non-negative integer values (ranging from 1 to 12), hence, the need for a model that accounts for count data as the estimation of Eq. 20 by traditional ordinary least square will lead to inefficient results. Following Cameron and Trivedi (1998) and Pedzisa *et al*., (2015), Poisson regression model assumes that the dependent variable y given the vector of predictor variables x has a Poisson distribution:

$$f(y_i \mid x_i) = \frac{e^{-\mu i}\mu_i^{yi}}{y_i!},\ yi = 0,1,2,... \qquad (20)$$

Wooldridge (2002) and Greene (2008) show that the mean and the variance of the poisson distribution in Eq. 21 is given as:

$$E[y_i \mid x_i] = Var[y_i \mid x_i] = \mu_i = \exp(x_i'\beta)\ for\ i = 1,2,...,n \qquad (21)$$

The log-linear conditional mean function $E[y_i \mid x_i] = \mu_i$ and its equidispersion $Var[y_i \mid x_i] = \mu_i$ assumptions are the main features of the Poisson regression model (Greene, 2008). The marginal effects in the Poisson model are given in Eq. 22 as:

$$\frac{\partial E(y_i / x_i)}{\partial x_i} = \mu_i \beta_i \tag{22}$$

This marginal effect, as in other count data models, is interpreted as the unit change in the intensity of adoption variable resulting from a change in the explanatory variable (Cameron and Trivedi, 1998).

We carry out the Poisson regression using either the *poisson* or *glm* command in STATA. Here we prefer the *glm* command because it produces the deviance that is useful in determining whether the poisson regression model is fit for the analysis or not. Alternatively, the *estat gof* command can be used to assess the goodness-of-fit chi-squared test of the model. If the goodness-of-fit chi-square test is not statistically significant, it implies that the Poisson regression model fits reasonably well, otherwise it indicates that the data do not fit the model well. In that case, there is a need to check if relevant variables are omitted or there is an issue of over-dispersion.

Assumptions of the Poisson model requires that the expected value (mean) of the Poisson distribution is theoretically equal to its variance, therefore, accounting for the inherent heteroscedasticity and skewed distribution of nonnegative data. Violation of the assumption of equality of the variance and conditional mean in a Poisson regression leads to over dispersion or under dispersion; Overdispersion means that the variance of the coefficient estimates is larger than anticipated mean, thus, resulting in inefficient, potentially biased parameter estimates and spuriously small standard errors (Kirui and Mirzabaev, 2015). Underdispersion, on the other hand, refers to a situation in which the conditional variance of the dependent is less than its conditional mean. In the presence of under- or over-dispersion, though still consistent, the estimates of the Poisson regression are inefficient and biased and may lead to misleading inference (Famoye *et al*., 2005; Greene, 2008, Kirui and Mirzabaev, 2015).

One way to detect this is by inspection of the Dispersion category below the deviance or Pearson chi-square statistics. This is the deviance or Pearson chi-square statistic divided by the number of degrees of freedom. If it is much larger than 1.0, it may indicate the presence of over dispersion. Poisson regression model becomes inappropriate when there is over or underdispersion. Count data with overdispersion can be modelled with the negative binomial

model which is fit in Stata either by the *nbreg* command or the *glm* command by specifying family (*nbinom*) as the family of distributions.

Binary Logistic Regression

The logit model is one of the qualitative response models which are usually applied when the dependent variable is dichotomous (food secure or insecure households) and not continuous. A binary logistic regression was used where the estimated probabilities lie between logical limit 0 and 1 (Gujarati, 1995). Food security as a dependent variable, thus, assumes the value of $Y = 1$ if a household is food secure, 0 otherwise. Following Gujarati (1995), the functional form of logistic regression model was specified as follows:

$$\prod(x) = 1 \Big/ 1 + e^{-Zi}$$

Where $\prod(x)$ is a probability of being food secure ranging from 0 to 1 and Z_i = is a function of n explanatory variables (X_i) which is also expressed as:

$$Z_i = \beta_o + \beta_i X_i + \beta_2 X_2 + ..., \beta_n X_n + U_i$$

In other words, the probability for a household to be food insecure can be expressed as,

$$1 - \prod(x) = 1 \Big/ 1 - e^{Zi}$$

Thus,

$$\prod(x) \Big/ 1 - \prod(x) = (1 + e^{Zi} \Big/ 1 + e^{-Zi}) = e^{Zi}$$

Then, the expression $\prod(x) \Big/ 1 - \prod(x)$ represents the odds ratio in favour of food security. It means the ratio of the probability that a household will be food secure to the probability that it will be food insecure.

Table 1. Variables used in the regression model and their expected signs

Variable	Definition	Expected Sign
HDDS	Household dietary diversity score	Dependent Variable
Food security status	Food secure =1; otherwise 0	Dependent Variable
Age	Age of household head in years	+
Agesq	Age square	-
Gender	Gender of household head (Female = 1; otherwise 0)	+
Married	Married = 1; otherwise 0	+
Economic active	Number of active labour force within the household	+
DepRatio	Dependency ratio obtained by dividing inactive labour force by the active labour force within a household.	-
Mkt_access	Geographic distance from the farm household to the closest market where food can be sold or bought in km	-
TLU	Tropical livestock unit[8]	+
SchlgYr	Year of schooling of the household head	+
CanBorrow	Can borrow = 1; otherwise 0	+
Offfarminc ~e	Off-farm income in naira	+
Farmsize_ Ha	Farm size (ha)	+
Purchased	Proportion of land that is purchased by the household	-
Leasehold	Proportion of land that is leased by the household	+
Communal	Proportion of cultivated land that is obtained through communal means	+
RightReg	Households with registered land	+

6. Results and Discussion

The results indicated that most (56.0%) of the smallholder farmers were within the age bracket of 31-50 across the six geopolitical zones with a typical farming household head having the mean age of 45 years. This implies that majority of the respondents were still in their active years implying significant participation in the farming activities. This result, however, contradicts the findings of Eze *et al.,* (2011) who did a similar study and obtained the mean age of his respondent to be 59 years. About 13.0% of the respondents were less than 30 years while only a few percents (13.0%) were in the aged group category.

As shown in Table 2, twenty-five percent of the respondents had no formal education while 23.0% and 22.0% had secondary and tertiary education respectively. This suggests that about one-quarter of the rice farmers in Nigeria could neither read nor write while only a few (6.0%)

[8] Tropical Livestock Unit (TLU) is an animal unit equivalent to live-weight of 250 kg. In this study, 1 head of cattle = 0.7 TLU, 1 camel = 1 TLU, 10 sheep or goats = 1 TLU, and a donkey = 0.5 TLU.

of them had Arabic education. However, the incidence of smallholder farmers with tertiary education may be as a result of the graduate farming scheme that was introduced by the federal government in 2016, which enabled the unemployed graduates to contribute to the national development by improving food production and the nation's food security.

Similarly, farming households with a family size of between 11 and 15 people took 38% with the average household size of nine people suggesting that most of the sampled respondents did not practice family planning. The mean size of household landholdings as 2.26ha portraying the respondents as smallholders. As shown in Table 2, about 14% of the respondents had a low DDS, half of the respondents (54%) had medium DDS while 31% had high DDS implying that majority of the sampled households had economic access to diverse foods. The mean DDS (6.21) obtained in this study was a little higher than the mean DDS reported by previous studies in developing countries. A mean DDS of 6.17 was reported in Pakistan, 5.81 reported in Nigeria and a mean DDS of 4.02 reported in South Africa (Ali *et al*., 2014; Labadarios *et al.*, 2011, Sanusi, 2010).

Table 2. Socio-economic Characteristics of Smallholders Farming Households by GPZs

GPZ	NC	NE	NW	SE	SS	SW	All
Variables	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Age group							
At most 30	21	22	13	4	12	6	13
31-40	26	29	25	25	32	23	26
41-50	29	27	32	33	24	31	30
51-60	16	15	20	16	13	22	18
Above 60	8	8	11	22	19	17	13
Mean Age (years)	***42***	***42***	***44***	***47***	***43***	***47***	***45***
Gender							
Male	90	96	94	97	84	81	90
Female	10	4	6	3	16	19	10
Marital Status							
Married	94	90	95	94	87	93	93
Single	5	9	3	3	9	2	4
Widow/Divorced	2	1	2	3	4	5	3
Education Attainment							
No formal education	32	23	32	13	21	14	25
Arabic education	4	2	15	0	0	0	6
Primary education	14	12	17	32	18	31	20
Secondary education	26	25	14	21	27	35	23
Tertiary education	22	38	18	30	21	17	22
Mean Education Attainment (years)	***7***	***9***	***6***	***9***	***8***	***8***	***8***
Household size							
1-5	22	30	16	43	30	41	27
6-10	20	13	23	15	19	7	17
11-15	37	42	35	35	37	46	38
Above 15	22	15	23	3	2	2	14
Mean Household size	***11***	***9***	***11***	***6***	***7***	***6***	***9***
Farm Size (ha)							
Large farm (>5Ha)	13	13	13	10	18	14	14
Medium farm (2 – 5 Ha)	29	20	27	23	26	24	26
Small farm (<2Ha)	58	67	60	67	56	62	61
Mean Farm size (ha)	***2.42***	***2.04***	***2.25***	***2.04***	***1.99***	***2.45***	***2.26***
HDD	19	2	30	4	9	36	31
LDD	11	22	36	23	2	6	14
MDD	20	9	42	8	8	14	54
Mean HDDS (no)	***6.49***	***4.29***	***6.03***	***4.61***	***6.54***	***7.75***	***6.21***

Source: Field Survey, 2017

Note: NC = North central; NE = Northeast; NW = Northwest; SE = Southeast; SS = South south; SW = Southwest.

Land Tenure and Property Rights of Smallholder Farmers in Nigeria

The 1,459 farmers whose data were used in this study provided plot-level information on a total 2,310 parcels of land that were cultivated by members of their farm households during the

2016/2017 farming season. Table 3 summarizes the farmland characteristics in terms of the size, mode of acquisition, the property rights enjoyed by the households on those lands and the status of registration on those parcels.

As shown in Table 3, 54.0% and 16.0% of the parcels have been inherited or purchased by the farm household respectively. Also 19.0% on leasehold while 11.0% were communal land. The proportion of parcels held on leasehold and communal agreement were found to be extremely (8.0% & 12.0% respectively) lower among farmers drawn from north west and north east.

With respect to key rights held, majority (71.0% - 78.0%) of the respondents across the study area possessed rights to – restrict others from their farm, grow tree crops and develop their parcels further by investing in an irrigating scheme for example, while two-third (64-67%) of them could either sell or transfer their land to the next generation. Also, 18.0% and 3.0% of the cultivated parcels had boundary survey and registered with the state government while only 8.0% and 5.0% of the parcels were registered with traditional council and local government respectively.

Table 3. Distribution of Cultivated Parcels by Tenure Types by Geo-Political Zones

GPZ	NC	NE	NW	SE	SS	SW	All
Acquisition mode %							
Inherited	62.0	70.0	60.0	54.0	55.0	30.0	54.0
Purchased	10.0	15.0	23.0	14.0	12.0	10.0	16.0
Leasehold	15.0	12.0	8.0	15.0	23.0	47.0	19.0
Communal	13.0	3.0	8.0	17.0	11.0	13.0	11.0
Rights Held on Farmland (%)							
Can Grow Tree crops	83.0	88.0	88.0	74.0	76.0	51.0	78.0
Can restrict access of others	74.0	85.0	83.0	72.0	71.0	43.0	71.0
Can develop structures on land	77.0	86.0	86.0	73.0	73.0	47.0	74.0
Can lease out to others	73.0	85.0	86.0	71.0	73.0	44.0	72.0
Can sell the land	65.0	83.0	82.0	67.0	64.0	38.0	67.0
Can bequeath to own children	63.0	82.0	78.0	60.0	63.0	36.0	64.0
Land titling Status %							
Has well defined boundaries	25.0	22.0	15.0	3.0	12.0	23.0	18.0
Registered with Traditional Council	14.0	6.0	9.0	4.0	2.0	4.0	8.0
Registered with Local Government	5.0	14.0	5.0	0.0	1.0	5.0	5.0
Registered with the State	4.0	3.0	3.0	0.0	3.0	5.0	3.0

Source: Field Survey; 2017

Considering the level of association between per caput recommended daily calorie intake and dietary diversity scores, we found that the former imposes greater penalty than the latter. About 45.3% of the households with high DDS were food secure while those with medium and low HDDS were 22.8% and 6.2% food secure respectively.

Table 4. Dietary Diversity Score (DDS) and Food Security Status (FSS)

DDS	Food Insecure n (%)	Food Secure n (%)	Total (no)	chi - sq. value
High DDS	250 (54.7%)	207 (45.3%)	457	
Low DDS	197 (93.8%)	13 (6.2%)	210	
Medium DDS	611 (77.20%)	180 (22.8%)	791	
Total	1059 (72.6%)	400 (27.4%)	1458	129.967***

Source: Field survey; 2017

Looking carefully at the Dispersion category on Table 5 the deviance or Pearson chi-square statistics. The deviance and Pearson chi-square statistic were divided by the number of maximum likelihood (ML) degrees of freedom to give the scaled deviance and Pearson value. The result shows that the scaled deviance value is 1.04 while that of scaled Pearson chi-square is 0.97 indicating that Poisson regression is an appropriate model for our analysis. However, if the value is much larger than 1.0, it may indicate the presence of over dispersion.

As hypothesized, there is a positive relationship between age and household dietary diversity score, even though the relationship is not linear as confirmed by the negative coefficient of the age squared. This implies that households tend to have a more economic access to diverse food groups in their early age, this is possibly due to having the entire household members that cut across the different age categories not restricted to the kind of food groups to consume but as they grow older later in life, age and sometimes health challenges restrict them from eating some food items.

A coefficient of 0.0061 on *Economic active* indicates that a farm household with more economically active member is expected to have 0.64% more economic access to food items. On the contrary, dietary diversity score reduces by 2.56% when the *DepRatio* changes by one unit. This result is expected because an increase in the number of dependents means more people are eating from the same resources, hence, the household members may not be able to take enough food when compared to a situation with smaller dependents.

Table 5. Poisson Model Results

	Household Dietary Diversity Score		Food security threshold	
	Coef.	z	Coef.	z
Age	0.0110**	2.13	-0.0283	-0.92
Agesq	-0.0001**	-2.05	0.0002	0.74
Gender	0.0842**	2.55	-0.0046	-0.02
Married	0.0010	0.02		
Economic active	0.0061*	1.69	-0.4324***	-9.69
DepRatio	-0.0256***	-3.96	-0.4562***	-7.98
SchlgYr	0.0055***	2.99	0.0090	0.79
Mktaccess	-0.0524	-1.5	-0.0010	-0.5
TLU	0.0011**	2.05		
CanBorrow	0.0677***	3.02	0.2267*	1.74
Offfarmincome	4.00E-08	1.34	3.75E-08	0.26
Farmsize_Ha	0.0021***	3.00	0.0073	1.01
Purchased	-0.0177	-0.49	-0.1106	-0.55
Leasehold	0.1482***	5.62	0.3105*	1.88
Communal	0.0910**	2.36	-0.0525	-0.23
RightReg	0.0369	0.88	0.4004*	1.73
Constant	1.4787***	11.9	2.0714***	2.68
Wald chi2(19)			172.46***	
Log pseudo-likelihood	-3307.61		-787.537	
Deviance	1468.564			
Pearson	1374.5			
(1/df) Deviance	1.0378			
(1/df) Pearson	0.9713			
AIC	4.6433			
BIC	-8815			

Source: Field Survey; 2017

This implies that the availability of adequate adult labour can have a positive effect on access to diverse food groups while a household with more dependency ratio compared to the economically active age group has less access to diverse food groups.

The parameter estimate for *SchlgYr* is positive and highly significantly different from zero and thus implies that education has a strong significantly positive effect on household dietary diversity. The parameter estimates of 0.0055 imply that an increase of the years of education leads to an increase in the economic access of household to diverse food by 0.55%, indicating that higher education translates to efficient use of agricultural input and technology and results in higher yield and then more income. The result corroborates the findings of Ahmed *et al*., (2015).

The estimated coefficient of market access is negative, implying that households in remoter regions have lower dietary diversity, though not significantly. Better market access through reduced distances could therefore, contribute to higher dietary diversity. This result is in agreement with the findings of Sibhatu *et al*., (2015). Another indicator of market access is the

availability of off-farm income sources. Off-farm income follows *a priori* expectation but not statistically significant. Results in Table 4 show that off-farm income is associated with higher dietary diversity. Many smallholders complement their farm income with off-farm income when employment opportunities in other sectors arise. Cash earnings from off-farm activities increase the households' ability to buy diverse foods from the market. Households are therefore encouraged to engage in multiple livelihood activities which will provide streams of income that enhance food access, thus, making the households to have an adequate diet.

Having access to agricultural credit was positively associated with the household dietary diversity score. Households that have access to credit would build their capacity to produce more through purchase and use of agricultural inputs and that would make it possible for those households to spend the credit on some other income generating activities, thus, positioning them to escape food insecurity crisis. This finding is in line with that of Olagunju *et al*., (2012).

Another important result is the positive and significant association due to farm size cultivated by the smallholder farmers. The positive association implies that, that an increase of the farm size by one (ha) leads to an approximately estimated increase in the economic access of household to diverse food by 0.21%. Thus, households with large farm size produce more for households and sale, affording them more income to access diverse food groups in the market. This result is in conformity with the findings of Beyene & Muche (2010).

The coefficients of 0.0011 on TLU indicates that households with large livestock size are expected to have 0.01% more access to different diets thus making them less vulnerable to food insecurity especially in times of drought when crops fail to yield. Therefore, possession of large size of livestock increases the economic access of household to diverse diet as they can earn additional income from their livestock. This result is in consonance with the findings of Beyene & Muche (2010) who found that there is a positive relationship between total livestock holdings and food security status of the households.

The proportion of farmland that is leased and obtained through communal means tend to increase dietary diversity by 14.82% and 9.10% respectively. The logistic result also indicates that the proportion of farmers that leased and have their land duly surveyed were more likely to be food secure as against their reference categories. Purchasing of farmland by the smallholder farmers was less likely to increase food security status of the farm households in the short run, however, it can result to increase in the household food security status as seen in the positive sign of farmers that had their land registered. This corroborates the evidence from

literature that secure land tenure provides incentives for farmers to invest and make improvements to their land to ensure full utilization of land (Roth and McCarthy, 2013).

Conclusions

The paper estimated the influence of LTPRs on household food security. Household food security was measured using per caput recommended daily calorie intake of 2100 kcal and household dietary diversity score (HDDS). This study makes use of the 2017 Federal University of Agriculture, Abeokuta (FUNAAB) ECOWAS RAAF PASANAO[9] Survey, a Nation-wide Survey of Cereals Production Systems and Willingness to Accept Incentives to Adopt Climate-smart Practices among Smallholders in Nigeria using household socio-economic cross-sectional survey data from 1,536 households. With reference to dietary diversity status of rural households from the study area, the paper found that about half of the respondents (54%) had medium DDS, 14% of the respondents had a low DDS while 31% had high DDS, implying that the majority of the sampled households had economic access to diverse foods.

Based on empirical results the paper concludes that:

i. Households should engage in multiple livelihood activities which will provide streams of income that enhance food access thus making the households to have an adequate diet.
ii. Rural education programmes specifically targeted for women to broaden their understanding of the nutritional health benefits of a diverse diet.
iii. Promotion of small-livestock investments.
iv. Land should be made available to farmers through leasehold and communal means by either the government or the community.
v. Since access to credit positively conditions rural households to attain high dietary diversity, therefore, enabling policy environment and institutional supports should be put in place to facilitate the provision of medium-long term credit to rural farm households in order to expand farmers' scale of production.

[9] Economic Community of West African States (ECOWAS) Regional Agency on Agriculture and Food (RAAF) Programme for Food and Nutrition Security in West Africa (PASANAO)

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