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DETERMINANTS OF DIETARY DIVERSITY AMONG SMALLHOLDER CROP FARMERS IN SOUTHERN NIGERIA

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ABSTRACT

Food and nutrition insecurity are on the rise in Nigeria, particularly among smallholder farmers, many of whom are poor. This study is aimed at identifying factors associated with smallholder crop farmers' dietary diversity in southern Nigeria. Using a multistage sampling procedure, data was collected from 2368 farmers across six states and analysed using descriptive, k-means clustering and multinomial logistic regression. Results showed that 27.36%, 46.83%, and 25.81% of the farmers were categorized as having poor food consumption, borderline and acceptable food consumption respectively. The econometric analysis showed that farmers' dietary diversity was significantly influenced by age, gender, education, household size, market distance and credit access among other variables. However, increasing years of education and farming experience were not translating to improved dietary diversity for the farmers. The study recommends creating non-farm job opportunities, investing in local markets and improving access to extension programs that enhance farmers' technological knowledge.

Keywords: Dietary diversity, Smallholder crop farmers, Food security, Food consumption, Southern Nigeria.

INTRODUCTION

Dietary diversity is a qualitative measure of food groups consumed within a specified period of time by an individual or households, reflecting access to a variety of foods in the referenced period (Omotayo, 2020). Dietary diversity which serves as an indicator for assessing households' food intake and level of food security (Yousaf et al., 2018; Nicholson et al., 2021), encompasses the access, availability and utilisation dimensions of food security. Hence, dietary diversity is a health-related indicator for the quality of dietary intake and level of food security (Matita et al., 2021). Literature has shown that a household's dietary diversity level is linked to its socioeconomic and food security status (Castell et al., 2015; Omotayo, 2020). Nigeria, like many other developing nations, is faced with food insecurity and malnutrition challenges, as more persons, including smallholder farmers, fall deeper into poverty traps (Omotayo, 2020; Statista, 2022). A number of studies have looked at the food and

nutrition security concerns in Nigeria, offering important insights into the difficulties confronting farmers. For instance, Ogunniyi et al. (2021) investigated dietary variety in Nigerian rural families, pointing to notable differences in food consumption habits and nutritional results.

Dietary diversity has been used to assess different aspects of food security, and it is sometimes used as an intermediate outcome indicator for evaluating nutritional outcomes (Pandey et al., 2016). This study measures dietary diversity with the Food Consumption Score (FCS) metric developed by the World Food Programme (Leroy et al., 2015) and further evaluates the factors influencing farmers' dietary diversity. Feyisa et al. (2023) used the food consumption score (FCS) as an indicator to evaluate the food and nutrition security of central and eastern Ethiopian farming households and thereafter employed the ordinary least squares (OLS) to identify the factors influencing the food and nutrition security

outcomes. The study contributes to the literature on dietary diversity of farmers in southern Nigeria by providing empirical evidence to support policy formulation towards reducing food and nutritional insecurity.

METHODOLOGY

The study was done in southern Nigeria, across six states; Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers State. The major agricultural activities in these states are fishing (including shrimping and deep-sea fishing) and crop farming. Majorly grown crops include yams, rice, cowpeas, maize, potatoes, banana, cocoyam, coconut, pear, fluted pumpkin, cassava, oil palms, rubber, timber, and cocoa (Anugwa & Agwu, 2018). In addition, livestock (poultry birds, pigs, sheep, goats and rabbits) production is common in the study area.

The study population consisted of registered cassava and yam producers in the study area. These crops are vital sources of carbohydrates in Nigeria, serving various purposes from direct consumption to industrial raw materials (Taylor et al., 2019). Data was collected through a multistage sampling procedure. In the first stage, two agricultural zones were purposively chosen from each of the six southern states and in the second stage, two local government areas (LGAs) were chosen, making a total of 24 LGAs. Thereafter, two communities, with high prevalence of cassava and yam production were selected per local government area to make a total of 48 communities from which farmers were randomly sampled. The required sample size (see appendix) was computed using the Yamane sample size computation formula as in Coker et al. (2017) to select 2,397 farmers from a population of 2,938,085 at 95% confidence interval and 5% precision level.

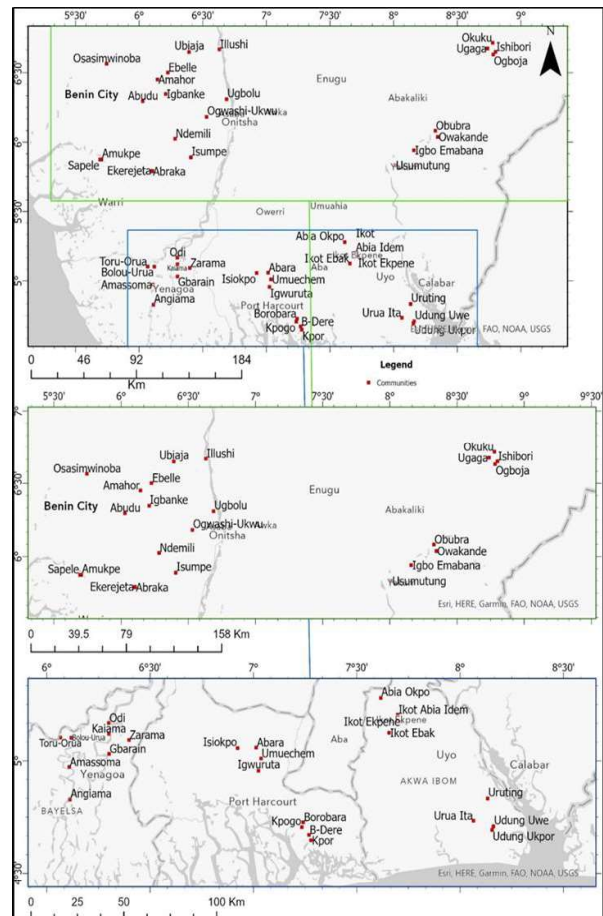


Figure 1: Map of the surveyed area
Source: Authors, 2023

Data was collected through the administration of questionnaire alongside personal interview. The data was analysed using descriptive statistics, cluster analysis and multinomial logit model with the aid of SPSS Version 26.0. The k-means clustering is a widely used method for segregating data into distinct groups and it is employed here for better understanding of the variations or similarities in dietary consumption among the farmers. The process generates a specific number of clusters or groups, identifies cluster centroids (means) and associates data points to the nearest centroid (Sgroi et al., 2024), thereby allowing the grouping of farmers with similar consumption patterns. The multinomial logistic model was chosen because the dependent variable (dietary diversity) has more than two categories, and this model does not pose any challenge in computing multivariate normal probabilities when compared to other choice models (Onyinyechi et al., 2019; Kotey et al., 2020).

Measurement of dietary diversity of farmers: The FCS is a composite score that takes into account three factors: the variety of diets in the home, the frequency of consumption of different food groups, and the nutritional value determined by weights. The farmers are asked about the type and frequency of consumption of different foods across eight food groups in the last seven days. The obtained consumption frequencies are then totalled and multiplied by standardized food group weight as shown in Table 1. The weighted scales are summed up for all the food groups and the composite score ranged from 0 to 112 as maximum score (assuming all the food groups were consumed by a farmer throughout the 7-days recall period). Higher FCS scores for a household indicate higher dietary diversity and frequency of food consumption.

The multinomial logistic model is used to identify factors influencing farmers' likelihood of being categorised as having poor, borderline or acceptable food consumption. The WFP (2008) recommends a threshold for classifying the households into three groups namely "poor" ($FCS \leq 21$), "borderline" ($21.5 - 35$) and acceptable ($FCS > 35$). However, as noted in Feyisa et al. (2023) the use of the thresholds for grouping could lead to wrong inferences if the dietary patterns of the people under study is not considered and as such they applied the OLS on the FCS. For instance, Subasinghe et al. (2021) observed high dietary diversity among surveyed households in Nigeria and it was attributed to the high affinity of the Nigerian people for fish particularly in the southern region. Likewise, in this study, given that consumption of meat, fish and starches are a daily occurrence in the study area, using the WFP recommended categorisation may not be appropriate. Consequently, the k-means cluster analysis in place of the WFP recommendation, was used to categorise the farmers into three groups and then multinomial logit was employed to identify factors influencing probability of a farmer falling into either of the three groups. In the context of this research, foods that belong to the food groups were appropriately listed on the interview schedule.

Multinomial Logistic Regression (MNL): The basic model of the MNL is as follows:

$$\Pr(Y_i = j | x) = \frac{\exp(x\beta_j)}{1 + \sum_{j=1}^{k-1} \exp(x\beta_j)}, j = 1, \dots, J \quad (1)$$

Where, where β_j is $K \times J$; $j = 1, \dots, J$. The probability of Y_i is within category j and below (that is, Y_i is in category 1, 2, ..., or j , whereas u_i is the error term. In this study, the MNRL model is expressed as:

$$\begin{aligned} &Pr(\text{Food Consumption Categories} \leq 3) \\ &= Pr(\beta_1 SX + \beta_2 AG + \beta_3 ED + \beta_4 HH + \beta_5 LO + \beta_6 MK + \\ &\beta_7 CA + \beta_8 EX + \beta_9 PD \\ &+ \beta_{10} IN + \beta_{12} EA + U_i \leq \alpha_3). \dots \dots \dots (2) \end{aligned}$$

Whereby, SX = sex; AG = age; ED = education; HH = household size; LO = land ownership; MK = market distance; CA = credit access; EX = experiential years of farming; PD = production diversification, IN = off/non-farm income; EA = extension service access, U = error term.

RESULTS AND DISCUSSION

Distribution of farmers by socioeconomic characteristics: The result in Table 2 presents the descriptive statistics of the farmers' socioeconomic attributes. It could be seen from Table 2 that the distribution of farmers by gender showed that more than half (57%) of the surveyed farmers were males. Average age of the farmers was 52 years; though majority (52%) were younger than 52 years. This demographic trend has implications for succession planning, knowledge transfer, and the overall sustainability of agricultural practices. Okon et al. (2019) underscored the importance of understanding the age composition of farmers and its impact on food security and rural development. It is also seen that the most share of the farmers had secondary education (36.49%) followed by those with primary education (27%). About 15% lacked any form of formal education, and which may make it more difficult for them to embrace contemporary farming methods and equipment (Kanter et al., 2019). Education can empower farmers to access needed skills and utilise available resources to boost their productivity (Kehinde et al., 2021).

Furthermore, the average family size consisted of 6 persons. Less than half (41%) of the farmers had accessed credit and only 30% have participated in extension service programmes. Majority (64.70%) of the farmers had over 18 years of farming experience, indicating a depth of traditional knowledge and skills in farming. Most of the farmers owned their farm lands; implying that long-term investments in land renovations could be encouraged as farmers feel more secure. Also, more

of the farmers possessed non-farm or off-farm income streams, which could enhance their access to variety of foods for nutrition security. In addition, a higher share (52%) of the farmers said that markets were far away from their farms and this could impact on their ability to sell produce and purchase varieties of nutritious foods. Pandey et al. (2016) pointed out that crop diversification has been found in some studies to significantly influence dietary diversity. More so, production diversification towards fruits and vegetables and aquaculture has shown potential to improve dietary diversity and nutritional outcomes (Pandey et al., 2016). The farm size of the farmers averaged 0.66 ha, an indication that they were generally marginal - smallholder farmers. Cluster analysis of farmers' food consumption scores.

The result in Table 3 presents the distribution of farmers by their food consumption score. FCS was categorised using the k-means clustering. It was observed that a higher share of the farmers (46.83%) fell into the borderline food consumption category, meaning that a significant proportion of farmers in the region may be at risk for food insecurity, either going through times of malnutrition or having restricted access to a variety of nutritious foods. This result is in agreement with the literature on state of food security in Nigeria, with research showing that households spend more than 70% of their total household budget on food (Owoo, 2020) and there is high incidence of dietary deficits and malnutrition across rural and urban households (Ecker et al., 2020; 2021).

Additionally, 27.36% of farmers are categorised as having poor food consumption, which highlights a worrying scenario where a sizable percentage of the population lacks access to nourishing meals or has chronic food shortages. This population is especially susceptible to the negative health effects of malnutrition, which can have long-term effects on both agricultural output and in turn, the health of individuals. About 25.80% of farmers are classified as having acceptable food consumption, implying that they have enough of diverse foods available to them to satisfy their nutritional needs. Although this group reports adequate food consumption, it is important to note that the group is a quarter of the overall population that was surveyed, indicating that a significant proportion of smallholder farmers in the

study area still have difficulties achieving food security.

Factors influencing smallholder farmers' dietary diversity: The k-means cluster classification of the farmers' FCS was regressed on selected socioeconomic indicators and the result presented in Table 4. The multinomial logit regression model would estimate $k-1$ models, where k is the number of levels of the dependent variable, and which in this case is 3 hence there are two models estimated. It can be seen from the result presented in Table 4 that for model 1, the multinomial logit estimate for being in poor food consumption group relative to adequate food consumption when all independent variables are zero is -0.510. Feyisa et al. (2023) noted the significant influence of age, education, ownership of livestock, off-farm income earnings and access to extension services on food consumption diversification. The result indicates that with increasing age, farmers have lower likelihood of having poor food consumption in comparison to those in adequate food consumption (base category). In other words, the log-odds of being in poor food category will reduce by 0.045 unit for older aged farmers compared to lower aged farmers. The result suggests that older aged farmers are less likely to experience food insecurity in the poor food and borderline consumption group compared to middle-aged and younger-age households. These findings though contradict Kerbo et al. (2024), may be explained by a number of factors, including scarce resources, and conflicting demands among younger aged farmers.

The coefficient of household size having positive sign implies that as household size increases, there is higher probability of poor food consumption. As noted in Opara & Johnson (2019), household size is inversely related to food security. Larger households tend to have more food expenditure which can affect income and worsen poverty levels, lead to poor food intake and health (Omotayo, 2020). A positive coefficient for education indicates that increasing years of education is associated with less likelihood of being in the adequate food consumption group, implying that being highly educated does not translate to being economically empowered to afford food consumption nor having a better understanding of nutrition to want food diversity. Better food security and nutritional diversity are expectedly associated with greater educational

attainment (Omotayo, 2020) as being highly educated has the potential to improve an individual's off-farm job prospects in certain situations, which might reduce the time and resources spent on agricultural operations and have an influence on food security (Bahiru et al., 2023). Increasing years of farming indicates a lesser likelihood of being in adequate food consumption group. This is an indication that the farmers are not realising the potential efficiency/productivity gains that could come from experiential knowledge gathered over time. The result is contrary to expectations as increasing years of farming (experience) is expected to have positive association with farm output. As opined in Adesiyani & Kehinde (2024), increasing years of experience would mean increasing knowledge of production technology that results in higher output and subsequently ensure or improve food security for the farming household. Female farmers have less diet diversity than their male counterparts. In other words, the log-odds of female farmers being in poor and borderline food consumption is higher when compared to the males by 0.33 given that other variables in the model are held constant. Women in their role are important to households' dietary diversity as they are often responsible for the preparation of foods in their households. Yet, a large body of literature has consistently shown that female-headed households have higher vulnerability to food insecurity and malnutrition than males (Lutomia et al., 2019; Kabeta et al., 2023). Several studies (e.g. O'Brien et al., 2022; Kabeta et al., 2023) have emphasised that several institutional and societal impediments prevent women from achieving food security and good nutritional outcomes, even in the face of attempts to advance gender equality and women's empowerment. The result is however contrary to Komatsu et al. (2018) which stated that women working in agriculture are associated with increased dietary diversity.

Furthermore, farmers who lived near markets and owned their farm lands have lower likelihood of having poor diet diversity than those who do not live near markets nor own their farm lands. The result implies that distance to markets can affect access to food and influence decision to consume adequate diet. Godrich et al. (2017) identified distance to food markets as a determinant of food security of individuals. Farmers not earning income from other

sources aside their farms and those without credit access are less likely to be in poor and borderline food consumption groups than those who depend mainly on farm income and those with access to credit. The result is in contrast to literature on the influence of income on food consumption. Studies (e.g. Bai et al., 2024; Hossain et al., 2024) have suggested that income level is positively associated with dietary diversity and as such individuals earning higher incomes are expected to eat more high-value products such as meat, fish, milk, fresh fruit and vegetables. Likewise, Matita et al. (2021) stated that increasing income enables households to afford a greater variety of foods, consequently leading to changes in food choices, greater diversity in consumed diet and better nutritional outcomes. In addition, the significant and positive coefficient of extension program participation implies that, compared to farmers with adequate food consumption, farmers who have not participated in extension training programmes have higher likelihood of being in poor dietary diversity group than those who have participated. This is expected because farmers who interact with extension service providers are expected to have access to better production techniques, improved inputs, and production incentives that can boost their farm productivity and output (Adesiyani & Kehinde, 2024). The model-fitting table (see appendix) showed the intercept-only model was significantly different from the final model, implying that the MNLR model adequately describes the data. The Nagelkerke R-square indicates that about 18% of the variation in the dependent variable is explained by the independent variables. Also, on the McFadden R Square, it indicates that in comparison to the null model, there was a 7.9% improvement in the outcome prediction given the predictors in the final model. Furthermore, the ordinal logistic regression was done initially and the test of parallel lines revealed that the assumption of the odds of the predictor falling into the dependent variable categories being same across the response categories was violated, thereby justifying the application of the MNLR to the data. The result of the MNLR emphasises the necessity of mainstreaming gender considerations into focused interventions to increase farmers' dietary diversity and also providing infrastructures like market and improving credit access.

CONCLUSION AND RECOMMENDATION

The study in general revealed majority of the farmers being classified as experiencing poor food – borderline food consumption. Also, the dietary diversity status of the farmers was significantly influenced by amongst other variables, age, gender, education, household size, market distance, credit access and extension participation in extension programs. However, higher years of education, and farming experience were not being effective as expected in improving the dietary diversity of the farmers. Likewise, land ownership, earning other non-farm income and credit access did not have the expected positive effects on the farmers’ dietary diversity. Thus, policy implications for the study is that younger-aged farmers should be supported to achieve higher diet diversity. There is need for more investment in local markets and the provision of educational programs that creates awareness among the public of the dietary consequences of large household size. Generally, there should be more focus on creating good non-farm job opportunities, supporting women empowerment and also enhancing farmers’ access to relevant quality extension programmes that improve their technological knowledge. Future research may consider investigating if there are gender and locational differences in the determinants of dietary diversity across the south-south region.

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Table 1: Food consumption score

Food Group	Weight
Main staples	2
Pulses	3
Vegetables	1
Fruit	1
Meat/fish	4
Milk	4
Sugar	0.5
Oil	0.5

Source: INDDEx Project (2018)

Table 2: Distribution of farmers by socioeconomic characteristics

Variables	Mean	Frequency (%)
Gender		
Male		1351(57.05)
Female		1017 (42.95)
Age (years)	52	
≤ 36		227 (9.59)
37 – 53		1003 (42.36)
≥ 54		1133 (47.85)
Education (number of years)	10	
Non-formal education		362 (15.29)
Primary		641 (27.07)
Secondary		864 (36.49)
Tertiary		501 (21.16)
House hold size	6	
Credit access (1 = Yes)		969 (40.92)
Extension services access (1 = Yes)		699 (29.52)
Farm experience (in years)	23	
≤ 18		827 (34.92)
19 – 36		1184 (50.00)
37 – 54		343 (14.48)
≥ 55		7 (0.30)
Land ownership (1 = Yes)		1737 (73.35)
Off/non-farm income (1 = Yes)		1411 (59.59)
Market distance		
Nearby		1136 (47.97)
Far away		1228 (51.86)
Production diversification		
≤ 2		2258 (95.40)
3 - 4		110 (4.60)
Farm size (ha)	0.66	

Source: Field Survey, 2023

Table 3: Cluster distribution of farmers' food consumption scores

Food Consumption Score	Profile	Frequency (%)
≤ 58.0	Poor food consumption	648 (27.36)
58.5 -76.0	Borderline food consumption	1109 (46.83)
≥ 76	Acceptable food consumption	611 (25.80)

Source: Field Survey, 2023.

Table 4: Estimates of multinomial logistics regression model

	Variables	B	Std	Sig.	Exp (B)
1	Intercept	-0.510	0.500	0.308	
	Farmers' age	-0.045	0.007	0.000***	0.956
	Education years	0.026	0.011	0.017**	1.026
	Household size	0.397	0.033	0.000***	1.488
	Farming experience	0.021	0.007	0.003***	1.021
	Gender (0 = Female)	0.329	0.124	0.008***	1.390
	Market distance (0 = Nearby)	-0.244	0.125	0.051**	0.783
	Land ownership (0 = No)	-0.686	0.137	0.000***	0.503
	Farm diversification (1= ≤ 2 products)	0.310	0.313	0.323	1.363
	Off/non-farm income (0 = No)	-0.381	0.130	0.003***	0.683
	Credit access (0 = No)	-0.644	0.139	0.000***	0.525
	Extension program participation (0 = No)	0.500	0.142	0.000***	1.649
	2	Intercept	-0.155	0.428	0.718
Farmers' age		-0.038	0.007	0.000***	0.962
Education years		0.052	0.010	0.000***	1.054
Household size		0.336	0.030	0.000***	1.400
Farming experience		0.036	0.006	0.000***	1.036
Gender (0 = Female)		0.326	0.112	0.004***	1.385
Market distance (0 = Nearby)		-0.185	0.112	0.098*	0.831
Land ownership (0 = No)		-0.652	0.120	0.000***	0.521
Farm diversification (1= ≤ 2 products)		-0.247	0.246	0.315	0.781
Off/non-farm income (0 = No)		-0.202	0.116	0.081*	0.817
Credit access (0 = No)		-0.284	0.124	0.022**	0.752
Extension program participation (0 = No)		0.233	0.125	0.062*	1.262
Diagnostics					
	Number of observations	2368			
	Log likelihood	4351.653			
	LR Chi-squared value	394.617***			
Pseudo R²					
	Cox and Snell	0.155			
	Nagelkerke	0.176			
	McFadden	0.079			

Source: Field Survey, 2023. Where 1 = Poor food consumption, 2 = Borderline food consumption, 3 = reference category (adequate food consumption), ***, ** and * is significance 1%, 5% and 10% level of probability respectively.

Appendix

Table A1: Sample size computation

State	Population	Sample size	Probability proportion of total population	Proportionate sample size
Akwa Ibom	572002	399.720	0.195	466.784
Bayelsa	178537	399.106	0.061	145.696
Cross River	532005	399.699	0.181	434.144
Delta	588842	399.728	0.200	480.526
Edo	434051	399.632	0.148	354.209
Rivers	632648	399.747	0.215	516.274
Total	2938085	2397.633	1.000	2397.633

Source: National Bureau of Statistics/Federal Ministry of Agriculture and Rural Development Collaborative Survey on National Agriculture Sample Survey (NASS), (2010/2011)

Sample size formula (Yamane 1967 cited in Coker et al., 2017):

$$n = \frac{N}{1+N(e)^2} \quad (i)$$

Where, n is the sample size of each State, N is the sample frame (population) of each State and e is the precision level or error of sample (taken as 0.05). While, in determining the size of questionnaires to be distributed to each state, the below formula is used.

$$n_h = n \frac{N_h}{N} \quad (ii)$$

Where, n_h is the proportionate sample size to be surveyed from individual State, N_h is population of crop farming households in each individual State, n is the total sample size (as computed from Yamane formula above) and N is the total population of crop farming households in all the States.

Multinomial Logistic Regression

Model	Model Fitting Information			
	Model Fitting Criteria -2 Log Likelihood	Chi-Square	Likelihood Ratio Tests df	Sig.
Intercept Only	4746.269			
Final	4351.653	394.617	22	.000

Pseudo R-Square	
Cox and Snell	.155
Nagelkerke	.176
McFadden	.079