Drivers of Food Security Amongst Plantain Producing Households in Edo State, Nigeria

Abstract

The agricultural sector in many countries continues to be plagued with diverse challenges which often tend to affect agricultural yield, thus posing a threat to food security. This reduced yield has the potential to pose a threat to achieving global food security. Due to the high occurrence of food insecurity, many households are devising strategies through which they can cope with the adverse effect of food insecurity. This study assessed the factors driving food security among plantain producing households in Edo State, Nigeria. Primary data was collected in 120 plantain producing households using a multi-stage random sampling technique and analyzed using food security index and logit regression model. The households' food security status was estimated at ₦555 (approx. $1), based on a daily minimum food bundle of 2260 kcal. The study showed that 46.7% of households were food insecure. The regression analysis for factors influencing food security revealed that older household heads tend to be more food insecure as compared to their younger counterpart. With a positive relation between farm size and food security, the likelihood of being food secure increases with farm size increase. Similarly, female headed households are more likely to be food secure. To cope with food insecurity, households have used coping strategies which include eating less of preferred food, limiting portion of food and skipping meals.

Key words: Food Security, Plantain, Farmers, Coping Strategies, Logit Regression

1. Introduction

Globally, agricultural households are faced with varying crises which often tend to affect their productivity. These crises or shocks could be economic or personal in nature or both in some cases. Typical examples of such shocks include reduced yield due to weather variability, death of household head or main income earner, price volatility, disease or pest outbreak, domestic and international policy variables such as exchange rates, interest rates, inflation, tariffs, theft, political instability or conflicts and unemployment, amongst others.

These shocks tend to affect the food security of smallholder farmers and their ability to ensure global food security. Food security according to Coleman-Jensen *et al.* (2012) refer to the access and provision of nutritionally accepted food by households for a healthy life. FAO (1996) defined food security as a situation that exists in which all people, at all times have

physical, economic and social access to sufficient, nutritious and safe food that meets their dietary needs and food preference for a healthy and active life.

As a result of the increase in the number of people that are food insecure and undernourished globally, the issue of food security has remained a worldwide concern especially in developing countries where the incidence is very high. This situation holds true as Abdullah et al (2019) reported that 92 percent of undernourished people are found living in Africa (226.4 million) and Asia (552 million). The situation is very critical especially in sub-Saharan African were feeding the ever-increasing population remains a huge challenge coupled with the fact that 90 percent of the rural population are poor and dependent on agriculture which is characterised by low productivity.

Amongst the global efforts towards achieving food security is the Sustainable Development Goals (SDGs) of the United Nation. The second SDG is targeted at ending hunger (zero hunger), achieving food security, improving nutrition and promoting sustainable agriculture by 2030. UNDP (2017) reported that the SDG2 would only be achieved by doubling small scale food producers' agricultural productivity and income.

Based on the FAO definition of food security and its domains (availability, stability, accessibility and utilization), the food security problem in Nigeria has been identified to be largely due to food access which is as a result of household income and low purchasing power. Due to the high level of household poverty, food access is reduced and this results into malnourishment (Fayeye & Ola 2007).

Plantain and banana are crops of great significance to human societies because globally, they represent the fourth most important food crop after rice, wheat and maize. Plantain also enjoys significant worldwide export (Phillp *et al.*, 2009). Prominent among the major pro-poor characteristics of plantain is its ability to survive extended periods of drought unlike majority of other staple crops. Generally, they can grow well under a wide range of soil conditions, with its fruits being produced almost all year round. Although fruits are produced almost all year round, major harvest comes during the dry season (November to February).

The plantain tree also has economic value apart from the fruits. In Nigeria, plantain peels are used as feed for livestock and in soap production. The dried leaves, sheath and petioles are used as knotting materials, sponges and roofing materials (Akinyemi *et al*., 2010). The fresh and dry leaves of plantain are also used for wrapping packaging, marketing and serving of food. Nutritionally, plantain contains a good amount of vitamin C and vitamin A. Plantains

are rich sources of B-complex vitamins (particularly in vitamin-B6), folates, niacin, riboflavin and thiamin. Also, so according (Jola, 2013) plantains provide adequate levels of minerals such as iron, magnesium and phosphorous.

It remains a viable source of income for small scale farmers and it is largely planted by small holder farmers who play a major role in food security and income generation for millions of poor rural regions around the world especially in African and Latin American countries (Babatunde et al 2010). Democratic Republic of the Congo, Uganda, Ghana, Rwanda, Colombia, and Nigeria are the largest producers of plantain with average yield of 15.7 tons/ha (FAOSTAT, 2017). In West and Central Africa, 70 million people have been estimated to derive over 25% of their carbohydrate from plantains (Swennen, 1990). Although the plantain sub-sector in Nigeria has the potential for exports, Nigeria is not amongst the major plantain exporting countries because it produces more for local consumption (Akintade, Okunola, Olaniyi & Akinbani, 2016; Akinyemi, Aiyelaagbe & Akyeampong, 2010).

Due to its peculiarity and versatility, a study of this nature is germane to understanding how plantain production contributes to household food security status in Nigeria most especially in Edo state where production is very high. Based on this premise, this study seeks to answer the following research questions: What are the socio-economic characteristics of households in the study area? What is the food security status of plantain producing households? What are the factors affecting the food security status of household in the study area? And what are the coping strategies used by households?

The main objective of this study is to assess the determinant of food security among plantain producing households in Edo State. The study will specifically: describe the socio-economic characteristics of plantain-producing households in the study area, determine the food security status among plantain producing household, determine the factors affecting the food security status of plantain producing households and identify the coping strategies used by households in the study area.

The paper is divided into various sections. The first section contains the introduction and objective while section two presents a stylized literature review. Section three contains information on the methodological review while section four presents the study results and conclusion.

2. Stylized Literature Facts

Based on the FAO's (1996) definition of food security, four components have been identified: availability, accessibility, stability and utilization. Issues relating to food availability, accessibility/affordability, and food utilization remain paramount among different stakeholders such as policymakers and academics. Availability of food implies sufficient food obtainable through personal production; food accessibility implies the availability of food with the household having the ability to purchase it; while food utilization refers to food having the entire required nutrient in it as required by an individual (Doppler, 2002). This is a challenge especially for people in developing countries, Nigeria inclusive.

The world is still facing serious food crisis, at least as perilous and life-threatening for millions of people. Although there is variation in the estimate of food insecure people globally, available statistics has shown that a large proportion of the world population have problem of food insecurity. According to a World Food Program estimate, hunger affects one out of seven people on the planet. The persistence of hunger in the developing world means that ensuring adequate and nutritious food for the population will remain the principal challenge facing policy makers in many developing countries in years to come (Stamoulis *et al*, 2004). For instance, sub-Saharan Africa and South Asia stand out as the two developing-country regions where the prevalence of human malnutrition remains high.

There are limited studies on socioeconomic determinants of plantain production in Nigeria. As such, there is a need to provide empirical evidence on socioeconomic factors that can influence plantain production. For instance, knowing how socioeconomic factors such as age, sex, educational level and extension contact amongst others affect food security will go a long way towards the designing of policies, projects and programmes so that there is inclusivity.

Elum and Tigiri (2018) examined the socioeconomic factors influencing plantain production in Khana local government area of Rivers state using simple linear regression fitting in four functional forms. The results of analysis showed that gender, age, household size and farm size influenced plantain production. Furthermore, using a four-point type of Likert's scale to measure factors militating against plantain production showed the major challenges to include poor processing and storage facilities, inadequate extension knowledge, unavailability of credit facilities, poor irrigation facilities, high perishability, high incidence of plantain disease and poor marketing system among others.

Amolegbe et al. (2021) used panel data from Nigeria to investigate the effects of non-seasonal food price volatility, in particular unexpected increases in prices, on household food security. Accounting for substitution effects and focusing on both domestic and imported rice—key components of the Nigerian diet—they found that imported rice price increases was damaging to both dietary diversity (downward impact) and the food share of consumption expenditure (upward impact), while impacts of domestic rice price volatility are ambiguous. They found that differential effects by wealth status varied across indicators of food security: an increase in the price of imported rice increases food share more among poor households than rich households, and decreases dietary diversity more among rich households than poor households.

Adio and Oladele (2021) examined the determinants of household food insecurity in Surulere Local Government Area of Oyo State using multistage random sample technique. The results of the food security status revealed that majority (58.33%) of the respondents described their food security status to be secured while others (41.67%) were of the view that their food security status was not secure. The result of binary Probit regression analysis also indicated that age, sex and education had a significant effects on food security at $p<0.05$ respectively. This study therefore concluded that since education is significant, farmers will be able to gain adequate knowledge on understanding the best ways of alleviating the problems of food security.

Using data from 250 maize farming households in Nigeria, Foster–Greer–Thorbecke and probit regression model was used to investigate the factors determining households food security. The food insecurity measure shows that 23.2% points of the households express the incidence of food insecurity while 5.5% points and 1.8% points were found to have depth and severity of food insecurity respectively. After controlling for households' socio-economic and demographic characteristics, the probit regression model suggested that, among others, value of output sold, education, credit access and participation in government safety nets program significantly influenced food security among the maize farmers in the study area (Ogunniyi *et al*., 2020)

In a study conducted by Obamiro *et al.* (2003) on the pillars of food security in rural areas of Nigeria using discriminant analysis, the study revealed that 52 and 48 percent of households were identified as food secure and food insecure respectively. Also, the household size, average farm size, cash crop grower/ non-grower, number of days lost to illness, income

group and amount spent on illness and accessibility to the market were found to be significant in determining whether a household is food secured or insecure.

Nkembi *et al*. (2021) examined the food security status of smallholder farming households, and specifically identified factors affecting household food security and the coping strategies used in case of food shortages. Households were selected through a simple random process from 11 villages around Mount Bamboutos and the main sources of income for farmers in the study area were crop production and animal production. The Household Food (In)Security Access Scale (HFIAS) was used to measure household food security. Forty five percent of the sampled households were food secure. Access to irrigation facility by household was positive and significantly influenced household food security as well as the duration of household head in the village. The main coping strategies in case of food shortages used by the farmers were: eating same food and skipping meals.

Agboola *et al* (2004) in their study using Tobit analysis revealed that household size, household net worth, input usage diversification extent, remittance, total expenditure, food allocation and crop output are the factors influencing food insecurity among rural farming households in Nigeria. The study also showed that 61 percent of the households were food insecure and the shortfall index revealed that the food insecure fell short of recommended calorie intake by 36%.

In a study on food security in Nigeria using discriminant analysis based on food expenditure and socio-demographic variables, Olayemi (1998) found that the greater percentage of total food expenditure goes to livestock and fish products while total household income, family size and level of formal education of household head are the key discriminating variable between food secure and insecure on national level. He observed that household income plus food and non-food expenditure profiles can provide considerable insight into household food security status.

Makinde (2000) in his study on the measurement and determinant of food security in Northern guinea savannah zone of Nigeria reported that family size, dependency ratio, household income and food expenditure were particularly significant in explaining food security in the study area. These findings are in consistent with (Falusi,1985).

Ajani (2011) investigated the determinants of food security of low income households in the University of Ibadan. The study revealed that 58 percent of households were food secured and the shortfall index estimated food deficit in the study area by 83 percent while aggregate

food gap for the group was 8089Kcalories per month. The study also showed that family size, dependency ratio and income were identified to be significant in explaining food security of low income workers' household in the study area.

3.0 Methodology

3.1 The Study Area

This study was carried out in Edo State. Ovia North East and Ovia South West Local Government Areas were purposively selected because they are the major plantain producing areas in Edo state. The state has annual rainfall usually above 1000mm/year, spread over 7 to 9 months. Forest soils in the southern belt of Nigeria are naturally fertile as a result of dense vegetation cover and are good for plantain production (Akinyemi et al., 2010). Figure 1 presents the map of Edo state showing the study area.

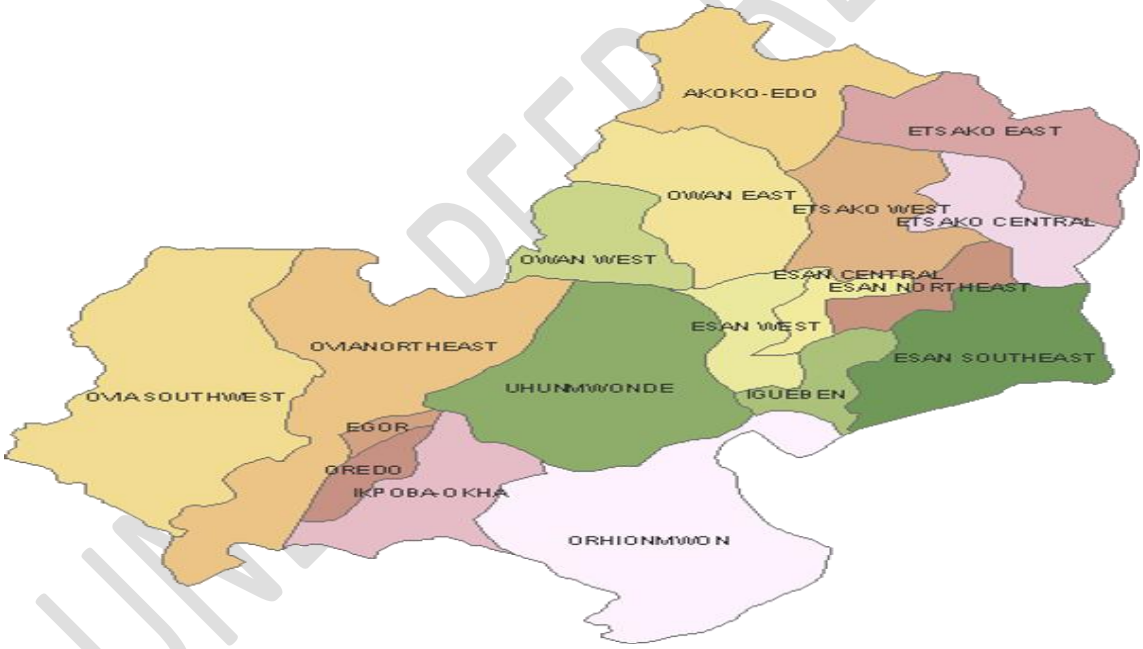

Figure 1: Map of Edo State

3.2 Data Collection and Sampling Techniques

The study made use of primary data obtained with the use of questionnaire. Multi stage sampling technique was used for the study. At stage one, two Local Government Areas (Ovia North East and Ovia South West) were purposively selected because of the prevalence of plantain producing households. Stage two involved the random selection of five communities

from each Local Government Areas. At stage three, twelve plantain producing households were randomly selected from each community to give a total number of 120 respondents.

3.3 Analytical Techniques

A combination of analytical tools was employed for the analysis. These include descriptive statistics, Food Security Index, Surplus/Shortfall Index and Logistic regression model. Descriptive statistics such as frequencies, mean, standard deviation and percentage were used to examine the socio-economic characteristics and the coping strategies used by households.

3.3.1 Food Security Index

The calorie intake estimation for food consumed by households in the study area was adapted following Akinyele and Oguntona (1995).

$$C_i = \sum \beta_j X_{ij} \quad \text{..... (1)}$$

Where: C_i is the daily calorie intake level per adult equivalent; β_j is the standardized food energy content of food commodity j adult equivalent; X_{ij} is the weight in grams of the daily intake of food commodity j by individual i. To obtain daily calorie intake per adult equivalent, daily calorie intake of each household was divided by its adult equivalent household size.

$$Adult\ equivalent\ daily\ calorie\ intake = \frac{House\ hold\ daily\ calorie\ intake}{House\ hold\ adult\ equivalent} \quad \text{..... (2)}$$

To determine the food security of plantain producing Households, the food security index Z was constructed to determine the food security of each household based on the food security line using the recommended daily calorie requirement approach following Babatunde *et al*. (2007). Households whose daily calorie intake were equal or greater than the recommended daily calorie required were considered food secure household and those whose daily calorie intake were below the recommended daily calorie required were considered food insecure households.

$$Food\ security\ index = \frac{Actual\ daily\ calorie\ intake\ of\ the\ house\ hold}{Recommended\ daily\ calorie\ requirement} \quad \text{..... (3)}$$

Using the Cost-of-Calorie (COC) function as employed by Oluyole *et al*. (2009), the function is stated as:

$$L_n X = a + bC \quad \text{..... (4)}$$

Where: X is Food expenditure (₦); and C is Calorie consumption (Kcal).

From the COC function, Z was estimated as

$$Z = e^{(a+bL)} \quad \text{..... (5)}$$

Where: Z is cost of minimum recommended energy level; L is recommended daily energy level (2260kcal); a is the intercept; and b is the coefficient of the calorie consumption (slope).

Household whose average cost of daily calorie consumption is more than Z is said to be food secured while any household with average cost of daily calories consumption lower than Z is said to be food insecure.

3.3.2 Logistic Regression Model

Logit regression model was used to determine factors influencing food security of plantain producing households. The dependent variable: food security status is a binary variable which takes a value of one (1) for food secured household and zero (0) for food insecure household. The model is mathematically stated in equation:

$$Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \mu_i \ldots\ldots (6)$$

Where: Z is the dependent variable (1 for food secure households; 0 for food insecure households); X is the vector of explanatory variables (predictors); α is the Intercept; β is the Slopes of the equation in the model; μ_i is the random error term.

The explanatory variables included in the model are: X_1 is the age of household head (years); X_2 is the sex of household head (1, if male and 0 if female); X_3 is the educational level (number of years of schooling of household head) (years); X_4 is the Household size (number); X_5 refers to the dependency ratio; X_6 is the farm size for plantain production (hectares); X_7 is the food total expenditure (₦).

4.0 Results and Discussion

4.1 Socioeconomic Characteristics of Plantain Producing Households

Table 1 presents the socioeconomic characteristics of plantain producing households. Majority (80.0%) of the sampled households were males. This pattern is very common among farming households Nigeria. This aligns with the findings of Oluyole et al. (2009). Distribution according to age has shown that a higher proportion were within the ages of 51 to 60 years. The mean age of an average farmer in the study area is 51.32±10.77 thus implying that they are still in their economically active age.

A typical household in the study area had an average of 8±4 persons. A large household is expected to provide more labour for on-farm activities. However, a large household could also be a threat to food security especially if there is a high level of dependents consisting of the elderly and children.

The distribution according to primary job experience has revealed that a higher proportion (45.0%) of the household heads had between 11 to 20 years of work experience. It was interesting to note that 33.3% of the household heads had no formal education while the rest had at least a form of education. Education is a social capital; hence, it impacts positively on household ability to take good and well-informed production and nutritional decisions. Therefore, education of household head could impact positively on food security status of household.

The study further investigated the occupational characteristics of the heads of household. The result as presented in Table 1 which showed that majority (80.80%) of the household heads engaged primarily in farming. The result further revealed that some others engaged in trading, commercial motorcycle riding and processing amongst others. The study further revealed that 36.7% of the plantain producing farmers had farm sizes that are between 1.5-2.0 hectares.

Table 1: Socio-economic characteristics of the households (n=120)

Description	Percent	Mean± S.D
Sex		
Male	80.0	
Female	20.0	
Age of the Household Head (Years)		
31 – 40	25.0	
41 – 50	25.0	
51 – 60	30.0	
≥ 61	20.0	51.32±10.77
Household Size		
< 4	11.7	
5 – 8	61.7	
9 – 12	8.3	
≥13	18.3	8±4
Primary Job Experience (Years)		
≤ 10	30.0	
11-20	45.0	
≥21	25.0	
Educational Level		
No formal education	33.3	
Vocational education	23.3	
Primary education	26.7	
Secondary education	10.0	
Tertiary education	6.7	
Type of Occupation (Multiple response)		
Farming	80.8	
Commercial bike rider	6.6	
Artisanship	9.2	
Teaching	5.8	

Trading	3.2
Processing	46.7
Farm Size (Hectares)	
<0.50	11.7
0.50 - 1.00	13.3
1.01 - 1.50	15.0
1.51 - 2.00	36.7
2.01 - 2.50	11.7
≥2.51	11.7

4.2 Households Food Security Status

In determining the food security status among plantain producing households in the study area, the food security index was used. The food security line was estimated at ₦555 per day. The result from Table 2 has revealed that 46.7% of the household were above this line thus implying that they are food secure while 53.3% fell below the line thus implying that they are food insecure. The implication of this is that 46.7% of the households spent at least ₦555 on per caput food consumption to attain the 2260kcal food energy requirement while 53.3% were unable to meet up with least ₦555 on per caput food consumption to attain the 2260kcal food energy requirement.

Table 2: Determination of Food Security status of the households

Food security status	Frequency	Percentage (%)
Food secure >2260kcal	56	46.7
Food insecure <2260kcal	64	53.3
Total	120	100

4.3 Factors Affecting the Food Security Status of Households

Table 3 presents the Logistic regression result of the factors affecting household food security status in the study area. The log- likelihood function of -10.374 has shown that the variables adopted gives the model a good fit. Out of the 7 variables fitted for the model, a variable with positive coefficients implies that the likelihood of a household to be food secured increases as the variable in question increase. Also, variables with negative signs indicates that such variable as an inverse relationship with food security of the household, thus implying that an increase in the variable in question will lead to a decrease in the food security status of the households and vice versa.

The result obtained has shown that age ($p<0.01$), sex ($p<0.05$), education ($p<0.10$), farm size ($p<0.01$) and total expenditure ($p<0.01$) were statistically significant at different levels with

varying signs. The age of the household head had a negative relationship with food security. The magnitude of the effect of age on food security reduces by 0.25436 with an increase in age of the household head. This implies that the probability of being food insecure is higher amongst older household heads as compared with the younger household heads. This finding corroborates that of Babatunde *et al.* (2007) and Ojogho (2010) who reported that older household heads were more likely to be less productive and may not be able to participate in more or rigorous income generating activities as compared with the younger ones, who are still within their economically active age. The result has further shown that the sex of the household heads had negative relationship with food security. The magnitude of household being food secure reduces by 0.7514 when the household head is a female.

Furthermore, the educational level of the household head negatively influenced their food security status thus implying that a year increase in the educational attainment of household heads will decrease the probability of being food secure by a magnitude of 0.1585. Similarly, farm size had positive relationship with food security. The magnitude of households' being food secure increases by 0.7160 with an increase in the farm size by one hectare. This aligns with the findings Elum and Tigiri, (2018) who reported that increase in the area of land cultivated will largely translate into a household being food secure.

The result has further shown that the total expenditure of the household head had negative relationship with food security. The magnitude of the households' being food secure will be reduced by 0.8789 if households' expenditure increase by one naira. The low value of the Wilks' Lambda (0.540) and the chi-square value of (50.235), significant at 10% have shown that the model is fit. The coefficients of the variables with positive signs indicate that an increase in such variable will increase the household's food security status.

Table 3: Factors affecting Household Food Security

Variables	Coefficients	t-ratio	Marginal Effect
Age	-25.725*** (9.4854)	-2.7120	-0.25436
Sex	-7.5994** (3.4111)	-2.2278	-0.75141E-01
Education(years)	-1.6034* (0.96233)	-1.6662	-015854E-01
Household size	4.5158 (2.9469)	1.5324	0.44651E-01
Dependency ratio	9.5759 (7.9689)	1.2017	0.94685E-01
Farm Size	7.2413*** (2.7394)	2.6434	0.71600E-01
Total expenditure	-8.8884***	-3.5400	-0.87886E-01

	(2.5109)	
Constant	169.5200	3.1700
Log- Likelihood function	-10.3740	
P- Value	0.00000	
Mcfadden R- Square	0.86647	

* Statistically significant at 10%; ** statistically significant 5%;

*** Statistically significant at 1%.

Percentage of right prediction 0.96667

4.4 Coping Strategies Employed by Households to Mitigate Food Security among Plantain Producing Farmers

In order to cope with periods of food scarcity and/or food insecurity, several households have utilized various strategies. Table 4 presents the coping strategies employed by households to mitigate food insecurity. They include: Limiting portion size of food for each household member (73.3%), or eating food that is less preferred (73.3%), some households (50%) also engaged in borrowing food or borrowing money to buy food.

Table 4: Coping Strategies Employed by Households to Mitigate Food Insecurity

Coping Strategies	Percent
Consumption coping strategies	
Skip meal for a whole day	
Yes	5.0
No	95.0
Reliance on wild food or fruits	
Yes	15.0
No	85.0
Short term labour migration	
Yes	23.7
No	76.3
Pledging	
Yes	30.0
No	70.0
Sales of assets	
Yes	25.0
No	75.0
Limiting portion size	
Yes	73.3
No	26.7
Borrowing food or money to buy food	
Yes	50.0
No	50.0
Depletion of stores	
Yes	18.3
No	81.7

Maternal buffering	
Yes	13.3
No	86.7
Skipping meals	
Yes	70.0
No	30.0
Eating food that is less preferred	
Yes	73.3
No	26.7

Many researchers have studied sociodemographic characteristics for their effect on agricultural production (Olivares et al. 2017; Olivares & Cortez, 2017). In a study carried out in Venezuela, age and education had a significant positive influence on the adoption of soil conservation measures and therefore on the production of certain crops (Olivares et al. 2016; Olivares, 2016). Also, the study by (Olivares & Franco, 2015) reported a positive influence of education on the adoption of conservation agriculture technology in tropical territories. Likewise, one study reported that female-headed households were more likely to adopt land and water technologies compared to male-headed households (Olivares, 2014). By age, older farmers were less likely to adopt practices that would improve agricultural production (Olivares et al., 2012a).

In order to identify suitable adaptation practices to a certain territory, it is necessary to previously establish the groups of actors involved, defined by similar characteristics from the point of view of land use, the production system (Olivares et al. 2012b), ethnicity (Olivares & Lopez, 2019), culture (Olivares et al. 2019), the territory where they do agriculture and the productive chains to which they belong (Olivares & Hernandez, 2019; Olivares et al. 2020a; 2020b). This stage facilitates the analysis of adaptation, since in general they will have similar threats, impacts and feasibility attributes compared to the proposed actions (Montenegro et al. 2021; Pitti et al. 2021,).

Conclusion

This study examined the factors driving food security among plantain producing households in Edo state, Nigeria. The result revealed that majority of the household heads were males, had at least a primary school education with farming as their major occupation. An average household head was 51.3 years and had an average household size of 8 people. The food security line (Z) was estimated at ₦555 to achieve the recommended minimum daily calorie intake of 2260kcal per day. Only 46.7% of the sampled households were food secured as compared to 53.3% that were food insecure.

From the study, the factors affecting household food security status of the sampled households were age, sex, education, farm size and total expenditure. The likelihood of being food secure was increased by increase in farm size as compared to sex, educational level, total expenditure and age which reduced the likelihood of being food secure.

Households employed at least one coping strategy in times of food insufficiency. Based on the findings of this study, we'll like to recommend that the government and stakeholders should provide basic educational institution and social amenities in the study area which will help to reduce the cost of non-food expenditures by plantain farmers.

REFERENCES

Abdullah, Zhou D., Shah T., Ali S., Ahmad W., Ud Din I. & Ilyas A. (2019). Factors affecting household food security in rural northern hinterland of Pakistan. *Journal of the Saudi Society of Agricultural Sciences, 18* (2), 201-210 https://doi.org/10.1016/j.jssas.2017.05.003

Adio, M. O., Oladele, A. B. (2021). Food insecurity and its determinants among farming households in Surulere Local Government Area of Oyo State. *South Asian Research Journal of Agriculture and Fisheries, 3*(2),10-16. https://doi.org/10.36346/sarjaf.2021.v03i02.001

Agboola, P.O., Ikpi A.E., and Kormawa P.M. (2004). Factors influencing food insecurity among rural farming households in Africa: Results of analysis from Nigeria. *Internet Discussion Paper*, November, 2004. <http/www.pjbs.org/pjnonline/ab577>

Ajani, O.I.Y. (2011). Determinants of food security of low-income households in University of Ibadan. *Journal of Rural Economics and Development, 14* (2), 91-98.

Akintade, F., Okunola, J. Olaniyi & Akinbani, A. (2016). Factors influencing adoption of plantain improved technology among small holder farmers in Edo State, Nigeria. *Journal of Biology, Agriculture and Health Care,* 6(6), 2224-3208.

Akinyemi, S.O.S., Aiyelaagbe, I.O.O., Akyeampong, E. (2010). Plantain (Musaspp.) Cultivation in Nigeria: A Review of Its Production, Marketing and Research in the Last Two Decades. Department of Horticulture, University of Agriculture, Abeokuta, Nigeria.

National Horticultural Research Institute, P.M.B. 5432, Ibadan, Nigeria. Acta Hort. 879, ISHS 2010

Amolegbe, K.B., Upton, J., Bageant, E. and Blom, S. (2021). Food price volatility and household food security: Evidence from Nigeria. *Food Policy Journal* https://doi.org/10.1016/j.foodpol.2021.102061

Babatunde, R. O., Omotosho, O. A. and Sholotan, O.S. (2007). Factors influencing food security status of rural farming households in north central Nigeria. *Agric. J. 2*(3), 351 – 357.

Doppler, W. (2002). Farming and rural systems approaches. Published Lecturing Material. Hohenheim University, Stuttgart, Germany.

Coleman-Jensen, A., Nord, M., Andrews, M. and Carlson, S. (2012). Household Food Security in the United States in 2011, ERR-141, U. S. Department of Agriculture, Economic Research Service, http://ers.usda.gov/publications/err-economic-research-report/err141.aspx

Elum, Z.A. and Tigiri, H. D. (2018). Socioeconomic factors influencing plantain production In Khana Local Government Area of Rivers State. *Journal of Agriculture and Food Sciences*, 16 (2):107-116.

Falusi, A.O. (1998). Agricultural Development and Food Production in Nigeria: Problems and Prospects.

Fayeye, T.R. & Ola, D.J. (2007). Strategies for food security and health improvement in the Sub-Saharan Africa. *World Journal of Agricultural Sciences, 3*(6), 808-814.

FAO. (1996). Rome declaration and World Food Summit of Action. www.fao.org/docrep/003/X8346E/x8346e02.htm#P1_10.

FAOSTAT (2017). FAO. Available online at: http://www.fao.org/faostat/en/#home

Jola, 2013). As cited by Elum, Z.A. and Tigiri, H. D. (2018). Socioeconomic factors influencing plantain production in Khana Local Government Area of Rivers State. *Journal of Agriculture and Food Sciences*, *16* (2), 107-116.

Makinde, K.O. (2000). Determinants of food security in Bauchi area of Northern Guinea Savannah. Unpublished Ph.D Thesis. University of Ibadan, Nigeria.

Nkembi, L. Herman, D.N., Mubeteneh, T.C. and Nkengafac. N.J. (2021) "Analysis of Small Scale Farmers Households Food Security in the Mount Bamboutos Ecosystem." *Journal of Food Security*, 9(2): 56-61. doi: 10.12691/jfs-9-2-3.

Obamiro E., Doppler W., Kormawa M. (2003). Pillars of food security in rural areas in Nigeria. *Food Africa, Internet Forum*. 31st March – 11 April.

Ogunniyi, A.I., Omotoso, S.O., Salman, K.K., Omotayo, A. O., Olagunju, K.O. and Aremu, A.O. (2020). Socio- economic drivers of food security among rural households in Nigeria: Evidence from smallholder maize farmers. *Social Indicators Research* https://doi.org/10.1007/s11205-020-02590-7

Oguntona, T. and Akinyele, I. O. (1995) *The Composition of Nigerian foods: Cooked, raw and processed*. Ibadan, Nigeria: Food Basket International.

Ojogho, O. (2010): Determinants of Food Insecurity among arable farmers in Edo State, Nigeria. *Agricultural Journal 5*(3), 151-156.

Olivares B, Lobo D, Cortez A, Rodríguez MF, Rey JC. (2017). Socio-economic characteristics and methods of agricultural production of indigenous community Kashaama, Anzoategui, Venezuela. *Rev. Fac. Agron. (LUZ)*. 34 (2): 187-215. https://n9.cl/p2gc5

Olivares B. (2016). Description of soil management in agricultural production systems of sector hammock in Anzoátegui, Venezuela. *La Granja: Revista de Ciencias de la Vida*. 23(1): 14–24. https://doi.org/10.17163/lgr.n23.2016.02

Olivares B, Franco E. (2015). Agrosocial diagnostic of the indigenous community of Kashaama: An empirical study in the state of Anzoategui, Venezuela. *Revista Científica Guillermo de Ockham*. 13 (1): 87-95. http://dx.doi.org/10.21500/22563202.1691

Olivares B. (2014). Application of Principal Component Analysis (PCA)in Socio-Environmental Diagnosis. Case: The Campo Alegre Sector, Simón Rodríguez Municipality, Anzoátegui. *Revista Multiciencias*. 14 (4): 364 – 374. https://n9.cl/caoee

Olivares B, Guevara E, Demey J. (2012a). The Use of Climate Biomarkers in Agricultural Production Systems, Anzoategui, Venezuela (In Spanish). *Revista Multiciencias*. 12 (2): 136-145. https://n9.cl/ak22r

Olivares B, López-Beltrán M, Lobo-Luján D. (2019). Changes in land use and vegetation in the Kashaama agrarian community, Anzoátegui, Venezuela: 2001-2013. *Revista Geográfica de América Central*. 2(63), 269-291. https://doi.org/10.15359/rgac.63-2.10

Olivares B, López M. (2019). Normalized Difference Vegetation Index (NDVI) applied to the agricultural indigenous territory of Kashaama, Venezuela. *UNED Research Journal*, 11(2), 112-121. https://doi.org/10.22458/urj.v11i2.2299

Olivares, B., Hernández, R. (2019).Ecoterritorial sectorization for the sustainable agricultural production of potato (*Solanum tuberosum* L.) in Carabobo, Venezuela. *Agricultural Science and Technology*. 20(2): 339-354. https://doi.org/10.21930/rcta.vol20_num2_art:1462

Olivares, B.; Hernandez, R.; Arias, A; Molina, JC., Pereira, Y. (2020a). Eco-territorial adaptability of tomato crops for sustainable agricultural production in Carabobo, Venezuela. *Idesia*, 38(2):95-102. http://dx.doi.org/10.4067/S0718-34292020000200095

Oluyole, K. A., Oni, O. A., Omonona, B. T. and Adenegan, K. O. (2009). Food Security among Cocoa Farming Households of Ondo State, Nigeria. *ARPN Journal of Agriculture and Biological Sciences* 4:7-13.

Pittí Rodríguez J, Olivares B, Montenegro E, Miller L, Ñango Y. (2021). The role of agriculture in the Changuinola District: a case of applied economics in Panama. *Tropical and Subtropical Agroecosystems*. 2021; *25*(1). from https://n9.cl/quyl2

Oluyole, K. A., Oni, O. A., Omonona, B. T. and Adenegan, K. O. (2009). Food security among cocoa farming households of Ondo State, Nigeria. *ARPN Journal of Agriculture and Biological Sciences, 4*,7-13.

Stamoulis, K.G., P. Pingali & Shetty, P. (2004). Emerging challenges for food and nutrition policy in developing countries. Special Issues on "Globalization of Food Systems: Impact on Food Security and Nutrition". *Journal of Agricultural and Development Economics, eJADE 1*(2), 154-167

Swennen, R. (1990). Plantain cultivation under West African conditions: A reference manual. Ibadan, Nigeria: Institute for Tropical Agriculture.

UNDP 2017). Strategic Plan, 2018-2021: http://undocs.org/DP/2017/38</p>