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Abstract

Nigeria, a leading populated country in Africa is constantly facing food insecurity crisis particularly among smallholder farming households. Despite the nutritional and economic significance of Underutilized Indigenous Vegetables (UIVs), also known as neglected vegetables, their contribution to household food security remains largely unexplored. This study assessed the socio-demographic characteristics of UIV farming households, evaluated their food security status, and examined the impact of UIV production on food security in Osun State, Nigeria. Primary data were obtained through structured-questionnaires, and a multistage sampling procedure was used to select 180 UIV farming households. Descriptive statistics, food security index, and logit regression were employed for data analysis. Results showed that the food security line was ₦5,029.08, 58.9% of households were classified as food secure, while 41.1percent were non-food secure. Food insecurity incidence, depth, and severity were 41.11%, 5.84%, and 1.77%, respectively. The Logit regression result revealed that education, income from UIVs, and credit access significantly increased the likelihood of being food secure, whereas household size and farm size did not. Policies promoting access to credit, extension services, and education among UIV farmers are essential to enhance food security and scale-up the potential of UIVs in the study area.

Keywords*: food security, logit regression, Underutilized Indigenous Vegetables (UIVs) farming households, Nigeria*

1.1 Introduction

The concept of food security was first presented at the World Food Conference in 1974, at that time it was merely understood from the perspective that a country had sufficient food available at the national level. However, this definition has evolved over the years and since then, different definitions have developed to better depict what food security really means [1]. Defining food security has

continued to evolve due to emerging concerns over inequitable distribution and access to food not just within countries, but also within households. Food security is importance to practitioners, policy makers and academics all over the world because the adverse effects of food insecurity are felt across every part of the society [2]. According to [3], food security is defined as a situation where everyone at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life, whereas food insecurity is the absence of one or more of these conditions.

Globally, close to 773 million people are chronically hungry, while approximately 2 billion people lack food security intermittently. 6 million children die of hunger every year, and 17,000 everyday [4]. Estimates show that earlier in the millennium, 200 million Africans were undernourished when compared to 133 million in the years before. This means that the rate at which undernourishment increases in Africa is more than it does in other developing nations. Similarly, Nigeria faces huge food security challenges in that, an estimated 70 percent Nigerian lives on less than US$1.25 per day. Nigeria ranked 110th out of 127 on the 2024 Global Hunger Index and 161th out of 193 on the 2023 United Nations Development Programme (UNDP) Human Development Index [5]. Hence, food insecurity is a problem of utmost concern worldwide, and particularly well-known in sub-Saharan Africa especially in Nigeria. The rural populace in Nigeria, especially women are generally faced with insufficient resources to purchase highly nutritious but expensive food items including but not limited to eggs, meat, milk and fish. Therefore, rather than starve, they gather indigenous vegetables to feed their households [6].

Indigenous vegetables refer to those vegetables that are either native to a particular region, or were introduced to that region for a long period to evolve through natural processes of farmer selection [7]. Indigenous vegetables are usually grown and consumed locally, and not for commercial purposes [8]. They are often considered as underutilized crops because they receive so little attention in terms of world trade and advancements in research. The obvious insufficient attention thus implies that their potential value is underestimated and underexploited [9]. Hence, in literature, indigenous vegetables are commonly mentioned as “minor crops,” “underutilized species”, “neglected species”, or “orphan crops”. Research conducted in southwest Nigeria by [10] showed that 53 species of vegetables across the southwest are gradually going into extinction

Research interventions like MicroVeg, a Canadian Government funded project with the objective to increase food, nutritional, and economic security of smallholder farming communities in southwestern Nigeria and Benin, promoted the cultivation of underutilized indigenous vegetables (UIVs) among resource-poor

farmers. This project's focus was to achieve its objectives through the acceleration of the large-scale adoption of UIVs and improved soil fertility management practices for their production. Having completed a baseline survey on many indigenous vegetables, attention was on three high-premium vegetables in southwestern Nigerian namely; Fluted pumpkin (Telferia occidentalis), African eggplant (Solanum macrocarpon) and Local Amaranth (Amaranthus viridis) because of their cross-cultural acceptability, marketability, in addition to high market value and economic returns [11].

UIVs are often grown in rural areas and they support a significant proportion of households who cultivate them, and this makes the rural population depend on UIVs both as a source of food and income [12]. Besides this, UIVs also empower smallholder farmers, particularly the women who otherwise could not get employed in the formal sector, and the income accruing from UIV production contributes significantly to enhancing household food security, access to family health care and also enables these households to attain some degree of financial independence within the family budget. For this reason, poor households rely on the consumption of these crops to fulfill their daily requirements of micronutrients [13].

Previous studies conducted on UIVs have shown that they generally constitute higher levels of different micronutrients than the conventionally cultivated species as well as cereals, and other common Nigerian staples [14,15], and in addition, some of them have invaluable medicinal-value properties and are grown for home consumption as well [16,17]. Asides from their nutritional, commercial and medicinal benefits, UIVs are of immense value with respect to sustainable food production because they reduce the impact of production systems on the environment. They are hardy species, adaptable to specific marginal soil and climatic conditions, and they can be cultivated with less external inputs as well [18].

The literature highlights that food insecurity is of uttermost concern. In addition to this, recent empirical studies conducted in some parts of Africa emphasize that UIVs are important commodities in household food [19,20], and cultivating them offers great potentials for increased revenues [12] for smallholder farming households and also improve their diets. Thus, diversifying food sources through the sustained production and consumption of UIVs which contribute to the fight against food insecurity and malnutrition is recommended [21]. Conversely, there is a dearth of empirical evidence on the food security status of UIV farming households in southwestern Nigeria, and the extent to which UIV production addresses food insecurity empirically remains unknown, hence this study. Therefore, the broad objective of this study is to analyze the contribution of UIV production to the food security of farming households in Osun State, Nigeria. The

specific objectives are to; describe the socioeconomic characteristics of UIV farming households; determine the food security status of UIV farming households; and estimate the effect of UIV production on household food security in the study area.

1.2 Materials and Methods

1.2.1 Study area

This study was carried out in Osun State, Nigeria. The State lies between latitude 7°30´N of the equator and longitude 4°30´E of the Greenwich meridian. It is bounded by Kwara State to the North, Oyo State in the West, Ogun State in the South, and Ondo and Ekiti States in the East. Based on recent estimates by the [22], Osun State has a population of over 4 million people and a land area of about 9,251km². The State is characterized by 2 distinct climatic seasons, namely the dry and wet season. The natural vegetation comprises moist evergreen and semi-evergreen forest and secondary forest. The mean annual rainfall in the State is 1400-2000mm, while the mean annual temperature ranges between 26 - 27°C. Over 90 percent of the rural populace is involved in farming. Osun State is known for the production of cash crops including cocoa, oil palm, kola as well as food crops like cassava, yam, maize and some fruits and vegetables [23].

1.2.2 Sampling procedure and sample size

A multistage sampling procedure was used to select the respondents for this study. The first stage was a purposive selection of 3 Local Government Areas where UIVs are grown. The second stage involved a purposive selection of 2 communities from each pre-selected Local Government Area. The purposive selection ensured that areas where the selected UIVs were cultivated were properly captured. At the final stage, 30 UIV farming households were randomly selected from each community to give a sample size of 180 respondents for the study. This approach is consistent with recent smallholder-based agricultural research in Nigeria [24].

1.2.3 Type of data and method of data collection

The study made use of primary data which were collected using structured-questionnaire. An initial proof of the validity of the structured questionnaire was made to ensure that the questions appeared relevant, clear, and appropriate. Content validity was confirmed by scrutinizing the questionnaire to ensure that it adequately covered all research objectives, and also align with both conceptual and theoretical frameworks. Regarding reliability, the questionnaire's consistency was evaluated using the test-retest method. A subset of respondents completed the questionnaire on two separate occasions, within a reasonable time gap between administrations. The responses from the two administrations were then compared to assess the instrument's reliability.

Data were collected on the socioeconomic characteristics of the respondents such as gender, age, level of education, household size, occupation of household en head, income from UIV, and expenditure of households on food as well as access to inputs such as credit and extension services. Interviews were conducted in local dialects where necessary to enhance accuracy and completeness.

1.3 Analytical Technique

The data collected from the survey were analysed using the food security index, descriptive statistics and logit regression. While the descriptive statistics such as frequency, percentage, mean and standard deviation were used to describe the socioeconomic characteristics of the respondents, the food security index was used to determine the food security status of the respondents and the logit regression estimated the effect of UIV production on food security.

1.3.1 Food security index (household food expenditure approach)

The food security status of UIV farming households was achieved by determining households' expenditure on food, from which the per capita household expenditure was estimated. The food security index was hence determined by dividing the per capita food expenditure of the i^{th} household by two-thirds of the mean per capita food expenditure of all households.

Having obtained the food security index, UIV farming households were then categorized as either being food secure or food insecure. This is mathematically expressed as;

$$F_i = \frac{\text{Per capita food expenditure of the } i^{th} \text{ household}}{^2/_3 \text{ of the mean per capita food expenditure of all households}}$$

Where F_i = food security index

Where $F_i > 1$ is the food secure i^{th} household, and $F_i < 1$ is the food insecure i^{th} household

When the per capita monthly food expenditure of a household is higher or equal to two-thirds of the mean per capita food expenditure, such households are classified as being food secure. In contrast, when the per capita food expenditure of a household falls below two-thirds of the mean monthly per capita food expenditure of all the surveyed households, such a household is said to be food insecure. With respect to the differences in household composition relating to age and sex, there is need to calculate the levels of expenditure required by households whose compositions vary. This is achieved by dividing the expenditure of the household by the size of the household, to get the per capita expenditure [25].

Following [26] using the Foster, Greer and Thorbecke poverty index, the food security index is measured as:

$F\alpha = \frac{1}{n}\sum_{i=1}^{q}\frac{z-yi}{z}$

Fα = Food security index z = food security line (mean per-capita food expenditure)

q = number of households below the food security line

n = total number of households in the population

yi = per capita food expenditure in increasing order for all households

α = the aversion parameter that takes values of 0,1 or 2.

When α = 0, Fα is the head count index measuring the incidence of food insecurity. That is, the proportion of food insecure people from the total population.

When α = 1, F_1 is the food insecurity gap, measuring the depth of food insecurity. That is, on the average, how far the food insecure is from the food security line.

When α = 2, F_2 is the severity of food insecurity among households. That is, the depth of food insecurity and inequality among the poor.

Logistic regression

Logistic regression model was used to estimate the effect of UIV production on food security. The model used is implicitly specified as;

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + - - - - - \beta nXn + i$

Where

Y= Food security status (Y=1 if food secure and Y=0 if otherwise)

β_0 = Intercept, β1 - - - - - βn = estimated parameters, X_1 - - - - - Xn = set of independent variables

X_1= age (years)

X_2= marital status (married =1, if other wise 0)

X_3 = level of education (years)

X_4 = household size (number)

X_5= farm size (acres)

X_6= farming experience (years)

X_7= access to credit (expressed as a dummy)

X_8= Income from UIVs (Naira)

i = error term

1.4 Results and Discussion

1.4.1 Socioeconomic Characteristics of the Respondents

The descriptive analysis of the socioeconomic characteristics of the respondents is shown on Table 1. Majority (74.44%) of the respondents were male while 25.56% were female. Most of the farmers (68.33%) were married and 27.77% were in their active years between 40 - 49 years of age. About 36.67% representing the majority of the respondents had spent between 7 - 12 years in obtaining formal education. Educational attainment among farmers is crucial for better decision-making and adoption of innovative practices [27]. The mean household size was 5 members. Farming was the main occupation of majority of the respondents and 39.44% of them had less than 10 years of experience in farming, cultivating a mean farm size of 2.24 acres to UIVs. Only 25.56% of the respondents had been visited by extension agents, while 26.11% had access to credit, underscoring persistent constraints in agricultural support systems [25].

Table 1 Socioeconomic characteristics of UIV farming households

	Frequency	Percentage	Mean	SD
Gender				
Male	134	74.44		
Female	46	25.56		
Total	180	100		
Marital status				
Single	38	21.11		
Married	123	68.33		
Divorced	15	8.33		
Separated	4	2.22		
Total	180	100		
Age			43.89	12.80
20-29	27	15.00		
30-39	37	20.56		

40-49	50	27.77		
50-59	37	20.56		
60-69	27	15.00		
>69	2	1.11		
Total	180	100		
Household size				
<5	90	50.00	5.23	3.37
6-10	77	42.78		
11-15	11	6.11		
>15	2	1.11		
Total	180	100		
Education level			10.93	4.38
Primary education	54	30.00		
Secondary education	66	36.67		
Tertiary education	60	33.33		
Total	180	100		
Farming experience			22.83	12.45
<10	71	39.44		
11-20	49	27.22		
21-30	43	23.90		
31-40	15	8.33		
41-50	2	1.11		
Total	180	100		
Primary occupation				
Farming	123	68.33		
Trading	41	22.78		
Civil service	11	6.11		
Artisan	5	2.78		
Total	180	100		
Farm size(acres)				
<1	37	20.55	2.24	1.14
1-1.9	28	15.56		
2-2.9	58	32.22		
3.3.9	47	26.11		
>3.9	10	5.56		
Total	180	100		
Extension visits				
Visited	46	25.56		
Not visited	134	74.44		
Total	180	100		
Access to credit				
Have access	47	26.11		
No access	133	73.89		
Total	180	100		

Table 2 shows the summary of food security indices of the respondents. From the study, the food security line of the UIV farming household was estimated using the per capita food expenditure of each household under study. Households were defined into food secure and food insecure groups based on their per capita food expenditure. The total monthly per capita expenditure of all households was ₦1,357,850.98 and the mean per capita food expenditure was ₦7,543.62. The food insecurity line was defined as two- third of the mean per capita food expenditure of all the households studied, and for this study the food security line was ₦5,029.08. Therefore, all households whose per capita expenditure fell below ₦5,029.08 were designated as food insecure, while households whose mean per capita food expenditure equal to, or greater than ₦5,029.08 were food secure.

Table 2 further indicates that 58.9 percent of the households in the study area were food secure, while only 41.11 percent were food insecure. This result suggests that rural UIV farming households in the study area are relatively food secure. Findings are in line with [28] which highlight that 54.2 percent of MicroVeg beneficiary households in Nigeria were food secure, and 45.8 were food insecure respectively. The food security indices; incidence, depth and severity are also shown on the Table. The food insecurity incidence for the households studied is found to be 41.11 percent, and it shows the pattern of food insecurity based on these household characteristics. The food insecurity depth for the UIV farming households sampled was 5.84 percent, and it measures the extent to which food insecure households were below the food security line. This implies that on the average, a food insecure household in the study area will require N293.54 monthly to exit food insecurity. The food insecurity severity refers not only to the distance separating the food insecure individual from the food security line (the food insecurity gap), but also the inequality in food expenditure among the UIV farming households. In the study, the food insecurity severity was 1.77 percent.

Table 2 Food security status of the respondents

Food security status	**Frequency**	**Percentage %)**
Food insecure	74	41.1
Food secure	106	58.9
Total	180	100
Food security indices	**Index**	**Percentage**

Incidence (F_{S0})	0.4111	41.11
Depth (F_{S1})	0.0584	5.84
Severity (F_{S2})	0.0177	1.77

1.4.2 Effect of UIV production on household food security in Osun State.

The logit regression for the effect of UIVs production on food security status of UIV farmers is presented on Table 3. The result for the logit regression shows that the log likelihood was -71.82, and the chi-square value of 100.16 was significant at 1percent This is an indication that the model is well fitted. The result also shows that the model was adequate in explaining the effect of UIV production on household food security. Out of the 8 explanatory variables included in the model, 5 were statistically significant. The significant variables were household size, farm size, access to credit, education, and UIV income.

Household size was significant at 1percent level and the negative sign on its coefficient shows an inverse relationship with food security. This implies that as the household size increases, the probability of being food secure decreases by 13percent In other words, larger households are more likely to be food insecure than smaller households, especially where the other members within the household do not generate any income but totally depend on the household head for their needs. This result corroborates with studies of [29], who highlighted the increased burden on household heads in larger families.

Farm size was also significant at 5% but its coefficient had a negative relationship with food security. This indicates that for a unit increase in the farm size used for UIVs production, the probability of becoming food secure decreases by 17 percent. This is contrary to the a priori expectation. This may be as a result of high cost of hired labour incurred for UIVs production in the study area, and more so when members of the household may not be available for farming activities [30].

Farmers' education was significant at 1percent and its coefficient had a positive sign showing a direct relationship with food security. This means that the more educated the farmer, the probability of becoming more food secure increases by 2 percent, and this coincides with a priori expectation. More educated farming household heads know how and what decision to take on the use of available resources to ensure that their households are food secure. This aligns with the findings of [31] although [32] found that farmer's level of education had no influence on the contribution of keyhole gardens to food security in Leribe district, Lesotho.

Access to credit was significant at 5 percent and its coefficient had a positive sign. This means that for a unit increase in UIV farmers' access to credit, the probability of becoming more food secure increases by 22 percent. UIV farmers who have more access to credit can increase their production, which in turn improves their food security status. This result corroborates results of [33] whose study revealed that having access to credit would enable the farmer to acquire land for production either by purchase, rent or lease, and the procurement of farm inputs will also be made possible. Productivity will be enhanced and this will also increase income of the farmers, thereby increasing food security of the households.

Income from UIVs was significant at 1 percent with a positive sign on its coefficient. This indicates that the probability of the household being food secure increases with an increase in the income from UIVs. The result corroborates with the findings of [31] and [34] who found that monthly and annual income from the cultivation of vegetables respectively, positively influences household food security status. [35] and [24] also found that increase in farm income increases the likelihood of household food security. [31] explained that farmers' monthly income obtained from sales of both vegetables and non-agricultural sources could be used to purchase other food items, and this will enhance the attainment of the household's food security status.

This further implies that educated household heads with moderate household sizes who have access to credit and income from UIVs are likely to be food secured.

Table 3 Logit regression of the effect of UIV production on household food security in Osun State

Variable	Coefficient	Marginal effect
Age	-0.0348	-0.0082
Marital status	-0.2537	0.0597
Household size	-0.5657	-0.1330***
Farm size	-0.7350	-0.1729**
Credit	0.9964	0.2179**
Education	0.0871	0.0204***
Farming Experience	0.0301	0.0070
UIV Income	1.28e-03	3.01e-06***
Constant	1.4024	
Prob > chi^2	0.0000***	
Wald chi^2	100.16	

Pseudo R^2	0.4108
Log pseudolikeli-hood	-71.82

*, **, and *** indicate statistical significance at the 10%, 5% and 1% alpha levels, respectively.

1.5 Conclusion

This study was carried out to estimate the food security status of UIV farming households and determine the effect of UIVs production on household food security in Osun State, Nigeria. The result of food security index showed that only 58.9 percent of UIV farming households were food secure and 41.1 percent were food insecure. It was found that household size, farm size, access to credit, years of education, and UIVs income were the important factors influencing UIV farming households' food security in the area. The study concludes that UIVs farming households in the study area are food secure, and provides empirical evidence that income of UIV enterprises contributes significantly to the improving farming households' food security.

1.6 Recommendation

Based on findings, the following policy recommendations are put forth. Government policies should prioritize the education of farmers through adult literacy programmes, and support extension agencies. Enhancing rural farmers' knowledge will promote the adoption of new farming technologies that will improve UIV production and enhance food security. More so, given the economic and nutritional potentials of UIVs, policies to integrate them into school feeding schemes, maternal and child nutrition, and other food initiatives should be formalized. These will boost dietary diversity among the vulnerable population. Furthermore, community land allocation policies and reforms should support the expansion of UIV farmers' farm sizes, as this will increase its production and commercialization. Furthermore, access and availability to credit facilities at subsidized interest rates will enable the UIV farming households to meet their financial obligation; buying of equipment and facilities necessary for the cultivation of these crops on a large scale. Special consideration should also be given to smallholders and women who dominate UIV enterprises. This will in-turn increase food security and self-sufficiency.

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Declaration of interest

The authors report that there are no competing interests to declare.

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Clinical Trial Number

Not applicable

Ethics declarations

Ethical approvals and consent to participate

The study was conducted according to existing ethical principles such as voluntary participation, confidentiality and anonymity of persons. The protocol was approved by Obafemi Awolowo University graduate school research committee, and all research procedures were performed in accordance with the Obafemi Awolowo University Postgraduate school's ethical guidelines and regulations, before the collection of the data. This study involved human participants, and all participants were duly informed about the purpose of the study prior to the data collection, and they voluntarily gave their informed consent. They were also informed of their right to withdraw from the survey at any given time without any adverse consequence. As part of ethical compliance, the information provided by the respondents remained anonymous and confidential and was made clear while introducing the questionnaires to the respondents. These steps ensured that the privacy and integrity of everybody participating in the study were preserved.

Consent for publication

Not applicable.

Data availability statement

The data that supports findings of this study are available on request from the corresponding author (E.R.M), due to privacy/ethical restrictions

Contribution statement

E.R.Mbossoh- original drafting, writing and editing, conceptualization, analysis

A.B. Ayanwale-writing, supervision

J.E.Sunday –writing and editing

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