Available: DOI: https://doi.org/10.54117/gjpas.v3i1.121 *Research article*

Gadau Journal of Pure and Allied Sciences
Gadau J Pure Alli Sci, 2(2): 30-40 (2024)
ISSN: 2955-1722
DOI: https://doi.org/10.54117/gjpas.v3i1.121

Effect of Bio-fortified Vitamin A Cassava on Poverty Status of Farming Households in Nigeria: Evidence from Oyo State

*Ibitoye, Olakunle Augustine[1] and Ogunwande, Isaac Olusegun[1]

[1]Department of Agricultural and Resource Economics
Federal University of Technology Akure, Ondo State, Nigeria.

**Correspondence:* kunaugustine@gmail.com; *+2348134744139*

Abstract

Profitable farming is a prime target of all farmers regardless of the scale of production adopted and the veritable opportunity to attain the threshold of bumper harvest is not unconnected with the adoption of new technology. The survey was carried out to investigate the effect of bio-fortified vitamin A cassava on the poverty status of the farming households in Nigeria using Oyo State as a case study. A multistage sampling technique was used to sample a total of 186 cassava farmers comprising 92 adopters and 94 non-adopters of bio-fortified vitamin A cassava variety using copies of well-structured questionnaires. Parametric tools used were descriptive statistics and probit regression for socioeconomic characteristics and adoption status analysis. The socioeconomic results showed that both the adopters and non-adopters were between the productive ages of 42 years and 59 years respectively. The majorities of farmers in the two categories were married and had formal education. Years of experience possessed by them were 11 years and 18 years while both groups are members of associations. Poverty classification result showed 41.3% of adopters being poor while 83.0% of non-adopters were poor. Marital status (2.1271<p=0.05), education (1.1510; p<0.1), seasonal income (0.0757; p=0.05) and poverty status (I.6019; p<0.1) had influence on the farmers' adoption status while lack of credit was highest indicator among the factors militating against adoption of bio-fortified vitamin A cassava. Bio-fortified vitamin A cassava remains the best option for farmers to experience improvement in cassava performance in both the quality and quantity terms and they are encouraged to adopt it in order to improve their households' welfare and increase their income. It is therefore recommended that stakeholders in the crop enterprise should make frantic efforts in providing credit and other basic inputs that will enhance improved vitamin A adoption.

Article History

Received: 12/01/2024
Accepted: 26/03/2024
Published: 30/06/2024

Keywords
Adoption; Farming Households; Poverty Status; Vitamin A Cassava

License: CC BY 4.0

Open Access Article

How to cite this paper: Ibitoye, O.A. and Ogunwande, I. O. (2024). Effect of Bio-fortified Vitamin A Cassasa on Poverty status of Farming Households in Nigeria: Evidence from Oyo state. *Gadau J Pure Alli Sci, 3(1): 30-40.* https://doi.org/10.54117/gjpas.v3i1.121

1.0 Introduction

Cassava is an important regional food source for about 200 million people (nearly one third of the population) of Sub-Saharan Africa (Abdoulaye *et al*., 2014). In Nigeria for instance, cassava root and leaves do not only serve as an essential source of calories but as a major source of income for rural household (Abdoulaye *et al*., 2014). Cassava provides food and income to over 30 million farmers and large numbers of processors and traders in Nigeria (Abdoulaye *et al*., 2014). Technological improvements (such as improved cassava varieties) is the most important factor in increasing agricultural productivity and reduction of poverty in the long-term (Solomon 2010; Solomon *et al.*, 2011). To increase productivity, technology must be adopted in the production, process and the rate of adoption of a new technology is subject to its profitability, and the degree of risk associated with it, capital requirements,

This work is published open access under the Creative Commons Attribution License 4.0, which permits free reuse, remix, redistribution and transformation provided due credit is given

agricultural policies and socioeconomic characteristics of farmers (Afolami *et al*., 2015).

Bio-fortification is an innovative process of enhancing the micronutrient composition of food crops (Olatade *et al*., 2016; Saltzman et al., 2016). Since local staple foods dominate the food consumption of the rural poor, bio-fortification of such local staples serves as an effective micronutrient deficiencies reduction strategy (Glopan, 2015; Rao and Annadana, 2017). In order to tackle the problem of vitamin A deficiency among rural populace, the harvest plus program was initiated to improve the vitamin A status of resource-poor farming households, especially women and children in developing countries such as Nigeria. The project facilitated breeding and delivery activities for micronutrient-dense cassava varieties, which are suitable for many agro-ecological conditions (Oparinde *et al.*, 2014). These varieties are expected to be adopted by farmers to improve their uptake of vitamin A.

The definition of adoption varies across studies, and the appropriateness of each approach depends on the particular context. Bekele *et al.*, (2003) used a simple dichotomous approach and defined a farmer as an adopter if he or she was found to be growing any improved materials. Thus, a farmer may be classified as an adopter and may still grow some local materials. This approach is most appropriate when farmers typically grow either local varieties or improved varieties. Where farmers are increasingly devoting more land to improved varieties while still growing some local varieties, a continuous measure of adoption is more appropriate. Many other studies used measures of the proportion of land allocated to improved varieties as the measure of adoption. According to Ann (2013), adoption of a technology could be slow in the beginning of the process, and some farmers never adopt even after the technology matures. Also, limited use of some improved cassava varieties previously developed by research institutions in Nigeria has been noted (Nweke *et al*., 2002).

Literature is awash with sufficient information on bio-fortified vitamin A cassava but the gap to be filled in the study which makes this study unprecedented is the creating of nexus between adoption vitamin A cassava and poverty status of farmers. The study, therefore, will answer the following research questions: what are the socioeconomic characteristics of the respondents? what is the poverty status of the farming households in the study area? and what are the factors determining the effect of adoption on poverty? The specific objectives are to identify the socioeconomic characteristics of the respondents; classify the respondents into different poverty groups and determine the effect of adoption on the poverty status of farming households among others.

1.1 Hypothesis for the Study

H_0: There is no significant relationship between the adoption of bio-fortified vitamin A cassava and the poverty status of the farmers.

2. 0 Materials and Methods

2.1 Study Area

This study was carried out in Oyo state of Nigeria, the capital is Ibadan. The dominant tribe in the state is Yoruba. It was created in 1991 from the old Oyo state. The state is located on longitudes 2^0 32'W and 4^0 08'E, and latitudes 7^0 34'N and 8^0 35'N. It is bounded in the North by Kwara state, bounded to the South by Ogun state, and bounded to the East and West by Osun and Benin republic respectively (Oyo State, 2023). The state has a total land area of 27,249 sq. km and a population of 5,591,589 with 2,809,840 males and 2,781,749 females (National Population Commission, 2006). It has thirty-three (33) Local Government Areas, under these are many big towns and villages such as Ibadan, Ogbomosho, Oyo, Iseyin, Shaki, Okeho, Kishi among others whose populations engage in various non-agricultural activities (such as teaching, civil service, artisans, among others) and agricultural enterprises ranging from production, distribution to marketing and exchange. The average bimodal rainfall regime of about 1,450mm and temperature of 27 ^{0}C dominate the entire area.

The forest reserve which confirms the potentialities of the soil in terms of supporting tree crops cultivation covers an area of 342,461 hectares and nine (9) farm settlements covering a total land area of 18,381.13 hectares in Iddo, Ilora, Ijaye, Ogbomoso, Iresa-Adu, Eruwa, Ipapo/Iseyin, Lalupon and Akufo; as a means of improving agriculture are present and functional in the state. The edaphic characteristics of the area revealed that the soil is moderately weathered thus retaining moisture optimally at the surface and also retain organic matter within the 5cm - 10cm depth. The notable arable crops in the area

are maize, yam, cassava, watermelon while the perennial crops are cashew, mango, cocoa, kola and shear butter among others.

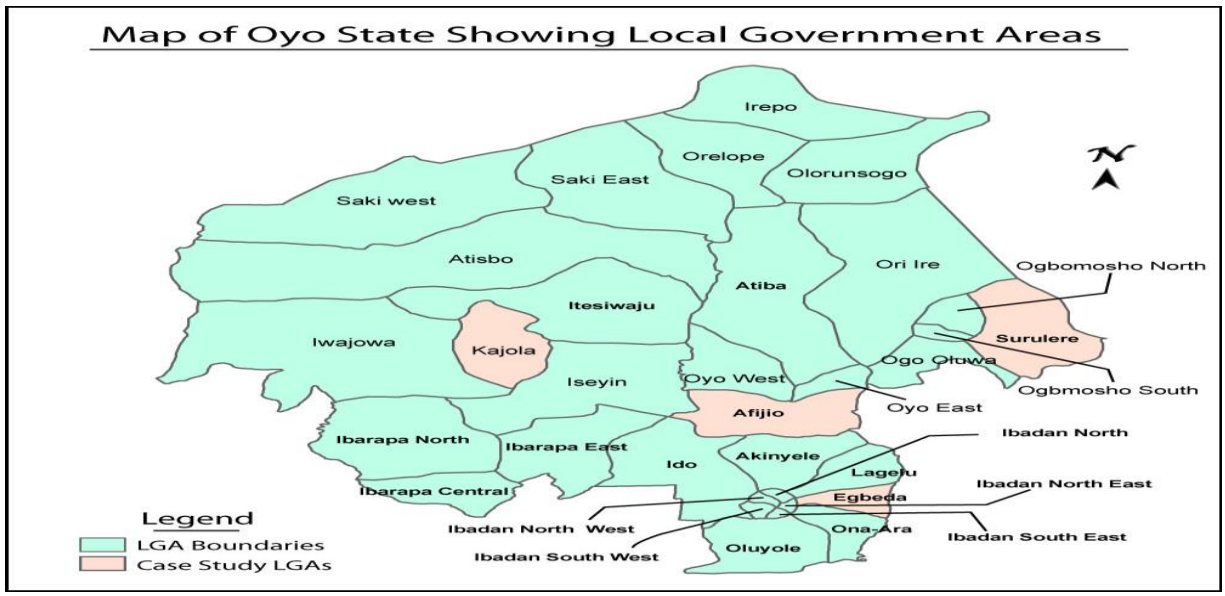

Figure 1: Map of Oyo State, Nigeria.
Source: Survey Division, Oyo State Agricultural Development Programme.

2.2 Sources of Data, Instrument and Method of Data Collection

Primary data was used for this study. Data was collected from both adopters and non-adopters of vitamin-A cassava with the use of structured questionnaire supplemented with oral interview. Data collected included: Socio-economic profile of the farmers, poverty status of the farmers and factors influencing it and the constraints militating against the adoption of vitamin-A cassava variety.

2.3 Sampling Techniques and Sample Size

The population of the study was cassava farmers in Oyo State, Nigeria. Multi-stage sampling procedure was used to select the sample for this study. In the first stage, purposive sampling technique was used to select one LGA (Block) from each of the four agricultural development project (ADP) zones (Ogbomosho, Ibadan-Ibarapa, Shaki, and Oyo zones) based on high concentration of cassava farmers cultivating different varieties of the crop. In the second stage, two cells were purposively selected from each of the LGAs (Block) previously selected due to prevalence of cassava farmers who are out-growers of vitamin-A cassava from International Institute of Tropical Agriculture (IITA) located in the State, making a total of 8 cells. In the third stage, random sampling technique was used to select two villages from each cell. In the fourth stage, 25 vitamin-A cassava adopters were randomly selected from the first 4 villages while 25 non-adopters of the variety were randomly selected from the other 4 villages. In all, a total of 100 adopters and 100 non-adopters of vitamin-A bio-fortified cassava variety was selected for this study.

Table 1: Sampling Design for the Selection of Respondents

State	Zone	Block	Cell	Community/ Villages	Planned Sample	Actual Sample
Oyo	Ibadan/Ibarapa	Egbeda	Erunmu	Ore kekere	14	14
				Ore-nla	14	13
			Owo Baale	Kasumu Ajia	14	13
				Owo Baale	15	14
	Oyo	Afijio	Jobele	Jobele	14	13
				Ilu Aje	14	13
			Fiditi	Aribombo	15	14
				Ilora	14	12
	Shaki	Itesiwaju	Ipapo	Ipapo	14	14
				Oke Amu	15	14
			Out	Otu	14	13
				Okaka	14	12
	Ogbomoso	Surulere	Iresa Adu	Iwofin	14	13
				Iregba	15	14
Total					200	186

Source: Field Survey, 2023

2.4 Analytical Tools

2.4.1 Descriptive Statistics

Descriptive statistics was used in analyzing the socioeconomic characteristics of the respondents. This comprise of frequency counts, percentages and the means.

2.4.2 Poverty Analysis

The analysis of poverty was based on P-alpha (α) measure proposed by Foster, Greer and Thorbecke (FGT) 1984. The use of FGT class of measure requires the definition of poverty line, which was calculated on the basis of disaggregated data on per capita annual consumption expenditure following Amao *et al.*, (2009). The FGT measure was based on a single mathematical formulation as follows:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\frac{(Z-Yi)^\alpha}{(Z)}$$

α = 0, $P_0 = \frac{1}{n}\sum_{i=0}^{n}(\frac{z-y}{z})^0 = \frac{q}{n}$ poverty incidence headcount

or

α = 1, $P_1 = \frac{1}{n}\sum_{i=0}^{n}(\frac{z-y}{z})^1$ poverty gap or depth

α = 2, $P_2 = \frac{1}{n}\sum_{i=0}^{n}(\frac{z-y}{z})^2$ poverty severity

Where;

Z = the poverty line obtained as 2/3 mean per capita annual expenditure

q = the number of individuals below poverty line

N = the total number of individuals in reference population.

Yi = the annual per capita expenditure of household i and,

α = the degree of aversion and takes on the values 0, 1, 2.

This study looked at the poverty incidence among adopters and non-adopters of vitamin-A cassava varieties in the study area (that is when α = 0). The poverty line is a predetermined and well-defined standard of annual income or value of consumption. In this study, the poverty line was based on the annual expenditure of the households. Two third of the mean per capita annual expenditure (2/3 of MPCHE) was used as the moderate poverty line. Respondents above this value was classified as non-poor (those spending greater than 2/3 of MPCHE) and those below it as poor.

2.4.3 Probit Regression Model

Probit model was used in estimating the probability of events based on dichotomous dependent variables. The model was used to determine factors influencing the poverty status of respondents in the study area. A dichotomous dependent variable assumes only two values (either zero or one). The model was specified as follows:

$$PD_i = \Phi\left(\sum_{j=1}^{n} \beta_j X_{ij}\right)$$

The linear probability function is expressed as:

$Y^*ji = \sigma_j + \beta_{j1}Z_{1ij} + \beta_{j2}Z_{2ij} + \ldots\ldots\beta_{jk}Z_{kij} + \varepsilon_{ji}$

Where;

$Y^*\sigma j$ remains constant across alternatives

βjk is a regression coefficient associated with the jth explanatory variable and the kth outcome for j= 1,2,3…….j-1

εji is a random error term reflecting intrinsically random choice.

The equation is expressed mathematically as:

$Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \ldots \beta_{10}X_{10} + U$

Where Y_i = Poverty status (poor =1, non-poor = 0)

X_i = Vector of explanatory variables

U = Error term

β = Vector of the parameter estimates

X_S are explanatory variables defined as follows

X_1 = Gender (Male=1; Female=0)

X_2 = Marital Status (Married=1; Otherwise=0)

X_3 = Education (in years)

X_4 = Age (in years)

X_5 = Farming experience (in years)

X_6 = Seasonal income (in Naira)

X_7 = Dependent household members (in No.)

X_8 = Cooperative membership (Yes=1; No=0)

X_9 = Adoption Status (Adoption=1; non-adoption=0)

X_{10} = Credit Access (Yes=1; No=0)

2.4.4 Test of Hypothesis

Student t-test was used to test the hypothesis of the relationship between adoption of vitamin A cassava and poverty status of cassava farmers in the study area.

$$t = \frac{X_1 - X_2}{S_{x_1x_2}\cdot\sqrt{\frac{2}{\pi}}}$$

where;

$$S_{x_1x_2} = \sqrt{\frac{1}{2}(S_1^2 + S_1^2)}$$

$S_{x_1x_2}$ is the grand standard deviation (or pooled standard deviation), 1= group one,

2 = group two. The denominator of t is the standard error of the difference between two means. For the significance testing, the degree of freedom for this test is 2n-2 where n is the number of participants.

3.0 Results and Discussion

3.1 Socioeconomic Characteristics of the Respondents

Results of the socioeconomic characteristics of adopters and non-adopters were presented in Table 1. The adopters had an average age of 42 years while the non-adopters had an average age of 59 years. These results suggest that both the adopters and the non-adopters of the improved cassava variety are in their productive age. Marital status revealed that the adopters and non-adopters had the majority of the population clustered in the married status indicating that they place a high premium on marital union which could be a source of pooling resources together for better investment opportunities and procreation which aids in the creation of family labour. About 57.6% of the adopters of vitamin A cassava formed the highest which both had secondary school education while about 51.2% of the non-adopters were the highest category of certificated primary school leavers. It could be inferred from this result that adopters of vitamin A cassava had more formal education than their counterparts who were non-adopters. This indicated that, more years of training in formal education enhances access and adoption of new variety of cassava in the study area.

Result of the farming experience of the farmers indicated that the adopters and non-adopters of vitamin A cassava had the years of experience between the age of 11years and 18 years respectively. It could be inferred from this result that more years of experience may not enhance acceptance of new technology as in some cases farmers with more years in farming may be conservative while farmers with lower years of experience have shown readiness to adopt new technology as in the case from this study. Adopters and non-adopters of the new variety of cassava had 5 members and 9 members in their households respectively. Due to more years of education among the adopters, they may have more exposure to family planning education than their non-adopting counterparts which may make them plan their reproductive lives for sizable family members. Farming was found to be famous as primary occupation among the adopters and non-adopters with the highest of 52.2% and 60.6% respectively. The result suggests that majority of those farmers cultivating cassava either as adopters or non-adopters of vitamin A cassava have farming as their main source of livelihood. Majority of adopters with 86.9% and non-adopters of vitamin A cassava with 56.4% were members of one association or the other.

The importance of membership of association was well realized by the farmers in both groups but the adopters of the improved variety of the improved cassava placed a higher premium on association membership. The benefits that are likely derivable from the membership may be for access to technical information, opportunities for training and credit acquisition advantage among others. Male respondents were dominant among the adopters with

61.9% with females being 38.1% of the total adopters. Males are 54.3% of the non-adopters while females are 45.7%. Males are dominant in both groups probably due to the fact that they are the custodians and managers of households' resources which they can mobilize to their personal advantage at any time.

The seasonal income realized by the adopters and non-adopters were in the respective of ₦678,072.83k and ₦379,675.51k. It is believed that the increased yield and high quality of the vitamin A cassava made the adopters realized more annual revenue than their non-adopting counterparts. Both the adopters and the non-adopters had extension contacts in the previous planting season with 61.9% and 54.3% respectively. It could be inferred from this result that there is a correlation between the number of extension contacts and farmers' performance.

The result on the farm size of farmers indicated that most of the adopters of vitamin A cassava cultivated medium farm size (2.1ha - 4.9ha) while the non-adopters cultivated small farm size (≤2ha) in the previous farming season with 52.2% and 67% respectively. The result suggests that with the new technology adopted by the farmers, they are always encouraged to cultivate more hectares of land for better performance and yield of crops. About 58% of adopters of vitamin A cassava practiced mono-cropping while about 81% of the non-adopters practiced mixed cropping. With the introduction of improved varieties of crops on the farm, farmers are encouraged to grow the crop alone in order to avoid competition of the crop for nutrients, water, air and other growth enhancing resources thus creating opportunity for comparison.

Table 2: Socioeconomic Characteristics of the Respondents

Variable	Adopters		Non-Adopters	
Age (in years)				
≤20	6	6.5	2	2.1
21-40	55	59.8	11	11.7
41-60	24	26.1	61	64.9
>60	7	7.6	20	21.3
Mean	42 years		59 years	
Marital Status				
Single	7	7.6	4	4.3
Married	75	81.5	65	69.1
Separated	2	2.2	19	20.2
Widowed	2	2.2	4	4.3
Divorced	6	6	2	2.1
Educational Level				
No Formal Education	2	2.3	24	25.5
Primary	25	27.2	48	51.2
Secondary	53	57.6	15	15.9
Tertiary	10	10.9	7	7.4
Farming Exp. (in years)				
≤10	16	17.4	4	4.3
11-20	45	48.9	50	53.2
21-30	25	27.2	24	25.5
>30	6	6.5	16	17.0
Mean	11 years			18 years

Household Size (in No.)				
≤6	52	56.6	13	13.8
7-10	29	31.5	55	58.5
11-15	7	7.6	17	18.1
>15	2	2.3	9	9.6
Total	5 members		9 members	
Primary Occupation				
Farming	48	52.2	57	60.6
Artisan	19	20.7	8	8.5
Civil/Public	15	16.3	5	5.4
Trading	10	10.8	24	25.5
Association Membership				
Yes	80	86.9	53	56.4
No	12	13.1	41	43.6
Gender				
Male	57	61.9	51	54.3
Female	35	38.1	43	45.7
Seasonal Income (in Naira)				
<200,000	8	8.7	21	22.4
200,001-400,000	12	13.0	56	59.5
400,001-600,000	26	28.3	8	8.5
>600,000	46	50.0	9	9.6
Mean	₦678,072.83		₦379,675.51	
Extension Contacts (No.)				
Yes	67	61.9	19	54.3
No	25	38.1	75	45.7
Farm size (in Hectares)				
Small (≤2.00)	21	22.8	63	67.0
Medium (2.1- 4.99)	48	52.2	17	18.1
Large (>4.99)	23	25.0	14	14.9
Mean	3.65 hectares		1.47 hectares	
Cropping System				
Mono-cropping	53	57.6	13	13.8
Mixed Cropping	26	28.3	76	80.9
Relay Cropping	13	14.1	5	5.3

Source: Field Survey, 2023

3.2. Classification of Respondents into Poverty Categories

Classification of respondents into different poverty status is presented in Table 3. Adopters who are core poor formed 22.8%, the moderately poor is 18.5% while the non-poor is 58.7%. It could be observed that the non-poor (58.7%) is higher than the poor (41.3%) by a margin of 17.4%. Comparatively, non-poor among the non-adopters are 17.0%, core poor (56.4%) and the moderately poor is 26.6%. Invariably, the adopters have 58.7% of non-poor and 41.3% of the poor while the non-adopters have 83% of the poor and 17.0% of the non-poor. The result suggests that the adopters of bio-fortified cassava variety had a higher number of the non-poor probably because the variety of cassava they cultivated is high-yielding which can easily make them realize more income when marketed and increase the household purchasing power. Conversely, farmers who are non-adopters had 83% of the poor group while 17.0% was otherwise. The cultivation of the open-pollinated variety brings lesser yield which when marketed may result in lower income and probably reduce their purchasing power

and lift their poverty status. The pooled data revealed that the non-poor was 37.6%, moderately poor (22.6%) and core poor (39.8%) amounting to poor (62.4% and non-poor (37.6%) in the entire study area.

The index for estimating the poverty headcount for the adopters and non-adopters of bio-fortified vitamin-A cassava was 0.4130 (41%) and 0.8298 (83%) respectively. This was used to calculate the number of people per capita expenditure below the poverty line as a proportion of the total population. Therefore, for the adopters, a poverty rate of about 41% indicates that 41 people are categorized as being poor in every population of hundred adopters in the area. Similarly, about 83% indicated that 83 are categorized as being poor in every population of hundred non-adopters. It could be inferred from this result that, the yield from improved cassava variety significantly impacts the adopters in terms of realizing more income from product sale.

Result on the poverty gap (P_1) as showed in Table 3 indicated that the adopters and non-adopters had 0.2034 (20%) and 0.4925 (49%) respectively. The index serves the purpose of measuring discrepancy of poor people towards the poverty line. Among the adopters of new variety of cassava, on average, the poor have 20% deprivation below the poverty line. This could be an indication that it would cost an average of 20% of the poverty line per poor farmer in order to lift them out of poverty through selective transfer. Similarly, for non-adopters, on average, the poor have 49% deprivation below the poverty line. This could be an indication that it would cost an average of 49% of the poverty line per poor farmer in order to lift them out of poverty through selective transfer.

Also, for the poverty severity, according to the result shown in Table 3, adopters and non-adopters had the severity indices of 0.0073 (1%) and 0.0414 (4%) respectively. This index described the expenditure among the poor farmers in the two groups. The adopters of the new variety of cassava had a poverty severity of 1% which indicates that the poorest 1% is worse off compared to poor people on average. This could be an indication that the poorest farmers have to mobilize financial resources of 1% more of the poverty line per farmers than is required for the average poor. Similarly, the non-adopters of the new variety of cassava had a poverty severity of 4% indicating that the poorest 4% is worse off compared to poor people on average. This could be an indication that the poorest farmers have to mobilize financial resources of 4% more of the poverty line per farmers than is required for the average poor.

Table 3: Classification of Respondents into Various Categories

Poverty Status	Adopter	Percent	Non-Adopters	Percent	Pooled Data	Percent
Core Poor	21	22.8	53	56.4	74	39.8
Moderately Poor	17	18.5	25	26.6	42	22.6
Non-Poor	54	58.7	16	17.0	70	37.6
Total	92	100.0	94	100.0	186	100.0
Poor	38	41.3	78	83.0	-	-
Non-poor	54	58.7	16	17.0	-	-
Pov. Headcount (P_0)	0.4130 (41%)			0.8298 (83%)		
Pov. Depth (P_1)	0.2034 (20%)			0.4925 (49%)		
Pov. Severity (P_2)	0.0073 (1%)			0.0414 (4%)		

Poverty line: Upper Limit (2/3) = ₦128,192.80, Lower limit (1/2) = ₦41,699.96

Source: Field Survey, 2023. *Note: Pov. Means Poverty*

3.3 Determinants of Adoption on the Poverty Status of the Respondents

The result from probit estimate determining the adoption on poverty status of the respondents is presented in Table 4. The diagnostic values indicated that likelihood ratio chi-square (243.19; $p<0.01$) shows that the model employed in the analysis was for and unbiased while the log-likelihood (-0.0732) shows that the model used was appropriate for the analysis. Four variables were found to be significant among the variables determining the adoption status of the respondents where marital status, education, seasonal income and poverty status were positively significant; meaning that they increase the adoption status of the respondents. Married respondents increased the probability of adoption status of the households in the area.

The result suggests that more income is generated from a household of more than one person than a single individual as this will increase their purchasing power and improve significantly on their livelihood. A unit increase in the years of education of the respondents increases the probability of adoption status of bio-fortified vitamin A cassava of the households by 1.1510. It could be inferred from this result that with the advancement in education, there is more likelihood that farmers will plant the new variety of the cassava. With an increase in the seasonal income of the respondents, there is a high probability that the adoption status of the household increases. A unit increase in the seasonal income of the respondents leads to an increase in the adoption status of the respondents.

This result suggests that, with an opportunity for a farmer to realize more seasonal income, he was able to meet up with the financial demands of planting the new variety of cassava (which involves the use of additional fertilizer, chemicals and new cropping systems), thus encouraging better participation in the planting of the new variety of cassava. The adoption status of cassava among the respondents remains the means of getting off the hook of poverty in the study area. Adopters of bio-fortified cassava have a high probability of being non-poor by 1.6019. The yield of hybrid cassava is always very high and based on this, farmers have more marketable surplus that could be converted to cash. This will assist the household in the purchase of variety of other commodities that they cannot produce on their own.

The result for the marginal effect revealed that all variables in the model are not significant but the non-poor status of the respondents were influenced by marital status, education, and farming experience, monthly income, cooperative membership and adoption status while it was negative for gender, age and dependent household members.

Table 4: Probit Estimate of Determinants of Adoption Effect on Poverty Status of the Respondents.

LR chi2 (10) = 243.19***				
Prob > chi2 = 0.000				
Pseudo R2 = 0.9432				
Log likelihood = -0.0732)	Y= (Yes= 1; No=0)			Marg. Eff.
Variable	Co-eff.	Std Error	Prob./Z/	dy/dx
Constant	1.1553	3.4490	0.608	-
Gender	-0.6998	1.3663	0.170	-0.0987
Mar. Status (Marr.=1; Non-Mar=0)	2.1271**	1.5504	0.039	0.3251
Education (in years)	1.1510*	0.5590	0.095	0.1589
Age (in years)	-0.1086	0.0649	0.104	-0.0150
Farming Experience (in years)	0.2153	0.1325	0.747	0.0297
Seasonal Income (in Naira)	0.0757**	0.2350	0.017	0.0104
Dep. Household Members (in No.)	-0.4430	1.8688	0.447	-0.6132
Cooperative Membership	0.8134	1.0701	0.157	0.1108
Poverty Status (Non-poor=1; poor=0)	1.6019*	1.1316	0.057	0.2643
Access to Credit (Yes=1; No=0)	0.7185	0.3773	0.738	0.0992

Note: Marg. Effect = Marginal Effect; ***, ** & * are significant at 1%, 5% & 10% respectively
Source: Field Survey, 2023.

3.4 Hypothesis for the Study

Hypothesis tested on the relationship between the adoption and poverty status of the cassava farmers in the study area. The null hypothesis expressed that there is no significant relationship between the adoption and poverty status of the respondents. The adoption status ($t=13.456$; $p<0.01$) and the poverty status ($t=14.988$; $p<0.01$) indicated that both the adoption status and the poverty status were significant at 1%. Based on this, the decision was to reject the null hypothesis and accept the alternative hypothesis stating that there is a relationship between the adoption and poverty status of the farmers cultivating cassava in the study area. This result suggests that, farmers who adopted the bio-fortified vitamin A variety of

cassava were not poor probably because of better yield and high demand for vitamin A cassava which resulted in higher revenue. With higher revenue, the purchasing power of the households cultivating vitamin A cassava increased, hence their welfare.

Table 5: Hypothesis Test between Adoption and Poverty among the Cassava Farmers

Variable	T	Df	Sig. (2-tailed)	Mean Difference
Adoption Status	13.456	185	0.000	0.49462
Poverty Status	14.988	185	0.000	0.54839

Source: Field Survey, 2023

4.0 Conclusion and Recommendations

The result on socioeconomic characteristics of adopters and non-adopters of bio-fortified vitamin-A cassava revealed that the average ages of adopters and non-adopters were between the age of 42 years and 59 years respectively which indicate that adopters were in their productive age but the reverse was the case for non-adopters. Result on gender of the respondents revealed that male adopters and non-adopters formed the highest in the two categories with 61.9% and 54.7% respectively indicating that men are still in charge of productive resources and mobilize then based on their decision and instructions. What is the % of the female adopters? If there is any.

Poverty classification of the respondents revealed that 41.3% of the adopters were poor while 58.7% were found to be non-poor. Also, in the group of non-adopters, 83% percent were poor, while a few of 17% were above the poverty line. Result of the poverty headcount (P_0) was 0.4130(41%), poverty depth (P_1) was 0.2034(20%) and poverty severity (P_2) stood at 0.0073(1%). Similarly, for non-adopters, the poverty headcount was estimated at 0.8298 (83%), poverty depth stood at 0.4925(49%) while poverty severity was 0.0414(4%). Probit estimate of the determinants of the poverty status of the respondents revealed that the non-poverty status of the farmers was significantly and positively influenced by marital status (2.1271; $p<0.05$), education (1.1510; $p<0.1$), seasonal income (0.0757; $p<0.05$) and adoption status (1.6019; $p<1.6019$). With an increase in all these variables, the non-poor status of the respondents increases. The result of the marginal effect showed no significant variables but gender, age and number of dependent members of the households positively influenced the non-poverty status.

Based on the findings in the study, it could be concluded that adoption of new variety of cassava by the respondents increased crop yield and by extension seasonal revenue. Increase in the revenue of the farmers means an increased in their purchasing power which ultimately led to poverty reduction and improved welfare

The study therefore recommends that stakeholders in agriculture should make effort to provide credit facilities for farmers in order to have sufficient funds in purchasing necessary inputs for growing the new variety of cassava, more extension contacts should be provided for the farmers to receive technical education and productive information that will assist them in developing more interest in farming and consider it a veritable income source, efforts should be made in encouraging female farmers to participate in the production of vitamin A cassava owing to the fact that when women are actively participating in farming, their children will pick interest and join in the production.

Declaration: I declare that there is no conflict of interest.

Ethics approval and consent to participate

Not Applicable

Consent for publication

All authors have read and consented to the submission of the manuscript.

Availability of data and material

Not Applicable.

Competing interests

All authors declare no competing interests.

Funding

There was no funding for the current report.

References

Abdoulaye, T., Abass, A., Maziya-Dixon, B., Tarawal, G., Okechukwu, R., Rusike, J., Alene, A., Manyong, V. and Ayedun, B. (2014). Awareness and adoption of improved cassava varieties and processing technologies in Nigeria. *Journal of Development Agricultural Economics*, 6(2):67–75.

Afolami, C. A., Obayelu, A. E. and Vaughan, I. I. (2015). Welfare impact of adoption of improved cassava varieties by rural households in South Western Nigeria. *Agriculture and Food Economics*, 3(1):18-34.

Amao, J.O., Awoyemi, T.T., Omonona, B.T and Falusi, A.O (2009). Determinants of poverty among fish farming households in Osun State, Nigeria. *International Journal of Agricultural Economics and rural development*, 2 (2):15-28.

Ann, H. (2013). The Dis-adoption of Recombinant Bovine Somatotrophin (rBST) and its Economic Impact: A Switching Regression Approach." *Applied Economic Perspectives and Policy*, 35 (3): 528–549.

Bekele, W. and Drake, L. (2003). Soil and Water Conservation Decision Behavior of Subsistence Farmers in the Eastern Highlands of Ethiopia: A Case Study of the Hunde-Lafto Area. *Journal of Ecological Economics.,* 46 (3): 437–451.

Foster, J. E., Greer, J. and Thorbecke, E. (1984). A Class of Decomposable Poverty Measures, *Econometrica*, 52(3): 761–766.

Glopan. (2015). Biofortification: An agricultural investment for nutrition. Global Panel on Agriculture and Food Systems for Nutrition Policy Brief No. 1. London, UK: pp 21-28.

National Population Commission (2006). Nigeria National Census: Population Distribution by Sex, State, LGAs and Senatorial District: 2006 Census Priority Tables., 3: 12-25.

Nweke, F. I., Dunstan, V., Spencer, C. and Lynam, J. K. (2002). The Cassava Transformation: Africa's Best-Kept Secret. East Lansing, MI, USA: Michigan State University Press.

Olatade, K. O., Olugbire, O. O., Adepoju, A. A., Aremu, F. J., and Oyedele, P. B. (2016). How does farmers' characteristics affect their willingness to adopt agricultural innovation? The case of biofortified cassava in Oyo State, Nigeria. *International Journal of Science and Technology*, *5*(2), 59–75.

Oparinde, A., Banerji, A., Birol, E. and Ilona, P. (2014). Information and Consumer Willingness to Pay for Biofortified Yellow Cassava: Evidence from Experimental Auctions in Nigeria. HarvestPlus Working Paper No. 13. Washington, DC, USA: International Food Policy Research Institute.

Oyo State (2023), the state. https://oyostate.gov.ng/about-oyo-state/Retrieved 2023/10/23.

Rao, C. K. and Annadana, S. (2017). Nutrient Biofortification of Staple Food Crops: Technologies, Products and Prospects. In: Benkeblia, N. (*Ed*). Phytonutritional Improvement of Crops, First Edition. John Wiley & Sons Ltd, New Jersey, United States.

Saltzman, A., Andersson, M. S., Asare-Marfo, Dorene-Lividini, K., De Moura, Fabiana, F., Moursi, M., Oparinde, A., and Taleon, V. (2016). Biofortification techniques to improve food security. In *Reference Module in Food Science, pp* 1–9.

Solomon, A. (2010). Estimating Welfare Effect of Modern Agricultural Technologies: A Micro-Perspective from Tanzania and Ethiopia. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Nairobi, Kenya.

Solomon, A., Bekele, S., Franklin, S. and Mekbib, G. H. (2011). Agricultural technology adoption, seed access constraints and commercialization in Ethiopia. *Journal of Development and Agricultural Economics.*, 3(9):436–447.