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DETERMINANTS OF ADOPTION OF BIO-FORTIFIED CASSAVA VARIETIES AMONG RURAL FARMERS IN BENUE STATE, NIGERIA.

Nwanguma, F. C.*, Jiriko, R.K. and Edegbo, R.O.****

National Root Crops Research Institute, Umudike, Abia State*
Department of Agricultural Extension and Communication, Joseph Sarwuan Tarka University, Makurdi**
Email: felixnrcri@yahoo.com*

Abstract

This study assessed determinants of Adoption of pro-vitamin A bio-fortified cassava varieties among rural farmers in Benue State, Nigeria. The population comprised all rural Pro-Vitamin A cassava farmers in Benue State. A sample size of 174 respondents was selected using a multi-stage selection technique comprising purposive, stratified, and simple random sampling. Data were collected using structured questionnaire and analyzed using both descriptive (frequency distribution, percentages, mean) and inferential statistics. Results revealed that majority (70.7%) of the respondents were aged between 41-50 years, male (70.7 %), had secondary education (52.3 %), cultivate <3 ha (97.7 %), and majority (78.2%) earned ₦750,000–1,000,000 annually. Agro-dealers ($\bar{x}$ =2.89) were farmer groups ($\bar{x}$ =2.87) are the main information sources. Majority (98.8%) of the respondents were of UMUCASS and UMUCASS (81.5 %), lowest for newer varieties (≤ 47.7 %). High-yielding potential ($\bar{x}$ =2.97), suitability for yellow gari ($\bar{x}$ =2.87), and low HCN content ($\bar{x}$ =2.83) drived positive perceptions. Inferential analysis confirmed that education and income significantly influenced adoption ($P<0.05$). Spearman's rank-order correlation showed a positive relationship between education level and adopt ($\rho = 0.412$, $p < 0.001$), while one-way ANOVA revealed a significant effect of income on adoption ($F = 4.22$, $p = 0.007$). These findings underscore the need for literacy-sensitive extension strategies and targeted campaigns through trusted agro-dealers and farmer networks to promote adoption of under-recognized varieties. It was recommended that targeted extension messaging through agro-dealers and farmer networks, plus literacy-sensitive awareness campaigns to boost adoption of under-known varieties should be encouraged.

Keywords *Determinants, adoption, Bio-fortification, Cassava, varieties.*

1.0 Introduction

Cassava (Manihot spp) is Nigeria's key staple, supporting over 70 million daily consumers and yielding, 63 million metric tonns annually (FAO, 2022). Cassava based meals are the most frequently eaten meals in the rural areas of Nigeria (Nweke *et al*., 2004).

Bio fortification aims to improve nutritional quality of food crops through agronomic practices, conventional plant breeding, or modern biotechnology (Onyeneke et al., 2019). Bio-fortified pro-vitamin A cassava varieties were introduced in two waves (2011 and 2014) to tackle widespread vitamin A deficiency (Oparinde et al., 2017). Despite varietal releases, adoption remains uneven, partly due to farmers' limited awareness and mixed perceptions (Onyeneke et al., 2019). Socio-economic traits (age, education, income, farm size) as well as access to information channels critically influence innovation uptake in rural contexts. Yet, there is scarce evidence linking these traits to awareness and attitudes towards pro-vitamin A cassava in Benue State, which is a major cassava-producing region. This study fills that gap by profiling rural farmers' characteristics, mapping their awareness levels, and quantifying perceptions of eight released varieties.

2.0 Objectives of the Study

The broad objective of this study was to assess Determinants of adoption of Bio-Fortified Cassava Varieties among Rural Farmers in Benue State, Nigeria. The specific objectives of the study were to:

i. describe the socio-economic characteristics of pro-vitamin A cassava farmers.
ii. identify primary agricultural information sources.
iii. ascertain awareness levels of released pro-vitamin A cassava varieties.
iv. identify determinants of adoption of pro-vitamin A cassava varieties

3.0 Methodology

3.1 The Study Area

The study was carried out in Benue State, Nigeria. Benue State is in the North central Nigeria, with total land area of approximately 34,059 km² and also with a present population of about 6,851,315 by United Nations population projection of 2022, using 2.3% growth rate (National Bureau of Statistics Demographic Statistics Bulletin (NBSDSB), 2022). The State lies within the lower river Benue trough in the middle belt region of Nigeria. Its geographic coordinates are longitudes 7° 47' and 10° 0' East. Latitudes 6° 25' and 8° 8' North [Benue State Agricultural and Rural Development Authority (BNARDA, 2010].

The State was created in 1976 among the 7 States created at that time by Gen. Murtala Muhammed. The State derives its name from the River Benue, which is the second largest river in Nigeria. The State shares borders with Nasarawa State to the North; Taraba State to the East; Kogi State to the West; Enugu State to the South-West; Ebonyi and Cross-Rivers States to the South; and has an international border with Cameroon to the South-East. It is inhabited predominantly by the Tiv, Idoma and Igede. Minority ethnic groups in Benue State are Etulo, Igbo, Jukun people and so forth. Its capital is Makurdi (Wikipedia, 2023).

The State has 23 Local Government Areas, divided into three Agricultural zones namely; North Eastern zone (Kastina-Ala, Ukum, Ushongo, Vandekya, Logo, Kwande and Konshisha Local Government Areas), North Western Zone (Gboko, Tarka, Buruku, Gwer-West, Gwer-East, Guma and Makurdi Local Government Areas) and Central Zone (Ado, Agatu, Apa, Otukpo, Ohimini, Ogbadibo, Obi, Okpokwu and Oju Local Government Area (Benue online, 2022).

Benue State has favourable agro-climatic ecologies for arable crops, tree crops and livestock production and enjoys two distinct seasons, wet and dry seasons. The rainy season begins from April to October, while the dry season starts from November to March. Annual rainfall record varies from 1700mm in the Southern part to 1250mm in the Northern part with annual temperature variation of 300C and 380C (BNARDA, 2010).

The State is blessed with abundant mineral resources and has many untapped mineral resources. Minerals such as limestone, kaolinite, Feldspar, gypsum and clay are found in the State (Soluap, 2023). About 80 per cent of the population is estimated to earn their living from agriculture (BNARDA, 2010). Benue State is a major producer of yam, cassava, sweet potato, millet and maize and tree crops such as mango, Orange and oil palm. Livestock rearing such as cattle, goats, pigs, and poultry are also found in the State. The people of the State are hospitable and cheerful. They are blessed with rich cultural heritage.



The study Area

Fig 1: Map of Benue State showing the location of the study area

3.2 Population and Sample Size Selection

The population of the study comprises all the rural Pro-Vitamin A cassava farmers in Benue State. A sample size of 174 respondents was selected using a multi-stage technique comprising purposive, stratified and simple random sampling techniques. In the first stage, Benue State was selected purposively, due to high population of cassava farmers. In the second stage, the population was stratified into the 3 already existing Agricultural Zones; North Eastern (Zone A), North Western (Zone B) and |Central (Zone C). In the third stage, two Local Government Areas were purposively selected from zone due to high level of pro-vitamin A cassava production, Kwande and Konshisha Local Government Areas (North Eastern), Bururku and Gwer West (North western) and Ado and Otukpo (Centeral Zone). Fourth stage, one rural community was randomly selected

from each of the selected Local Government Areas. In the final stage, a sampling frame was developed for each of the selected rural communities and using proportional allocation of 25 per cent (0.25) across board, a sample size of 174 respondents was obtained (Table 1). Data for this study were collected using structured questionnaire.

2.3 Data Analysis Techniques

Data for this study were analyzed using descriptive statistics such as frequency distribution, percentages and mean, as well as inferential statistics such as Spearman's rank correlation coefficient (rho) and One-way ANOVA.

4.0 Results and Discussion

4.1 Socio-economic characteristics

Table 2 shows that majority (70.69%) of the respondents were males and had average age of 46.6 years. Majority (83.91%) were married and had attained secondary education (52.30%), while household sizes were moderate, with 64.37% living in homes of 6–10 members. Table 2 shows that most (56.90%) had farmed for more than 15 years, and the average duration of cultivating pro-vitamin A cassava was 9.35 years. Despite this experience, farm sizes remained small, with 97.70% cultivating between 1–3 hectares. Income levels were modest but stable, with 78.16% earning between ₦750,001− ₦1,000,000 annually. These characteristics suggest a farming population with moderate education and experience, capable of adopting innovations but constrained by land and financial resources.

4.2 Sources of information

Information access was largely informal and decentralized. Farmers rated agro-input dealers ($\bar{x}$ = 2.88) and farmer groups ($\bar{x}$ = 2.86) as their most significant sources of agricultural information, followed by friends, relatives, and farmer networks. In

contrast, traditional extension services ($\bar{x}$ = 1.24), online/mobile platforms ($\bar{x}$ = 1.45), and mass media channels like television and newspapers were considered ineffective. This reliance on peer-based and commercial networks highlights the erosion of formal extension systems and the need to strengthen institutional outreach, especially in rural areas.

Table 2: Socio-Economic Characteristics of the Respondents (n= 174)

Variables	Category	Freq	(%)	mean
Sex	Female	51	29.31	
	Male	123	70.69	
Age (Years)	21–30	6	9.20	
	31–40	27	15.52	
	41–50	66	37.93	46.60
	51–60	59	33.91	
	Above 60	6	3.45	
Household Size	1–5	59	33.91	
	6–10	112	64.37	6.45
	11–15	2	1.15	
	Above 15	1	0.57	
Marital Status	Single	8	4.60	
	Married	146	83.91	
	Widow/Widower	18	10.34	
	Divorced	2	1.15	
Level of Education	Non-formal Education	7	4.02	
	Primary	37	21.26	
	Secondary	91	52.30	
	Tertiary	39	22.41	
Farming Experience (Years)	1–5	1	0.57	
	6–10	34	19.54	
	11–15	40	22.90	
	Above 15	99	56.90	20.33
Years Cultivating Vitamin A Cassava	1–5	21	12.14	
	6–10	112	64.74	9.35
	11–15	38	21.39	
	Above 15	3	1.73	
Farm Size (Hectares)	1–3	170	97.70	1.84
	3.1–5.0	2	1.15	
	Above 5	2	1.15	
Annual Income (₦)	≤ 500,000	1	0.57	
	500,001–750,000	5	2.87	
	750,001–1,000,000	136	78.16	934,944
	Above 1,000,000	32	18.39	

4.3 Awareness level

Awareness of released pro-vitamin A cassava varieties was uneven. UMUCASS 36 and 37 had the highest recognition (98.8% and 81.5%, respectively), reflecting their longer presence and promotional efforts. Awareness of UMUCASS 38 was moderate (44.8%), while UMUCASS 42 was barely known (2.9%). These disparities suggest that newer varieties suffer from limited exposure and inadequate dissemination strategies, underscoring the need for targeted campaigns to boost visibility and uptake.

Farmers' perceptions of varietal attributes were strongly aligned with practical and economic priorities. High yield ($\bar{x} = 2.96$), suitability for yellow gari ($\bar{x} = 2.86$), and low hydrogen cyanide (HCN) content ($\bar{x} = 2.82$) were the most valued traits, reflecting dual goals of food security and marketability. Other positively perceived traits included pest resistance, palatability, and health benefits. However, drought resistance ($\bar{x} = 2.04$), quick market sales ($\bar{x} = 2.20$), and wheat substitution ($\bar{x} = 2.21$) were rated lower, indicating either limited relevance or lack of awareness about these features.

4.4 Determinants of adoption of pro-vitamin A cassava variaties

Farmers with secondary or tertiary education demonstrated higher awareness, likely due to their ability to access and interpret varietal information. Those earning above ₦750,000 annually showed more favorable perceptions, suggesting that financial capacity enables investment in improved varieties and enhances commercial returns. Experience also mattered—farmers with over 10 years cultivating pro-vitamin A cassava exhibited deeper awareness and more nuanced perceptions, reflecting accumulated exposure and learning.

To accelerate diffusion of bio-fortified cassava, extension strategies must be tailored to farmers' literacy levels and socio-economic realities. Leveraging trusted agro-dealers

and peer networks can enhance credibility and reach, while deploying mass media in local languages can broaden access. Strengthening formal extension services and integrating them with informal channels will be key to improving awareness and adoption of newer varieties.

In conclusion, the study underscores the pivotal role of socio-economic factors—particularly education, income, and experience—in influencing farmers' awareness and perception of bio-fortified cassava. Strategic, context-sensitive interventions are essential to bridge gaps in varietal knowledge and promote widespread adoption.

Table 3: Sourcesof Agricultural Information Available to the Farmers

Variable	Mean	Remarks
Agro-Input Dealers	2.88*	SAI
Farmer Groups	2.86*	SAI
Friends/Relatives/Neighbors	2.61*	SAI
Farmer Networks	2.54*	SAI
Radio	2.30	NSAI
Cooperative Society	2.18	NSAI
Research Institutions	2.05	NSAI
Leaflet/Newspaper	1.71	NSAI
Television	1.58	NSAI
Online Mobile Technologies	1.45	NSAI
Extension Services	1.24	NSAI

Cut off mean = 2.50
SAI= Source of Agricultural Information
NSAI=Not Source of Agricultural Information

Table 3: Awareness of Pro-Vitamin A Cassava variet

Variety	(%)
UMUCASS 36 (TMS13	98.8 %
UMUCASS 37 (TMS13	81.5 %
UMUCASS 38 (TMS14	44.8 %
UMUCASS 42 (TMS05	2.9

4.0 Conclusion and Recommendations

4.1 Conclusion

This study has demonstrated that farmers' socio-economic characteristics, particularly education, income, and farming experience play a pivotal role in shaping their awareness and perception of pro-vitamin A bio-fortified cassava varieties in Benue State. The findings reveal that middle-aged male farmers with secondary education dominate cassava production, and while they possess substantial farming experience, they operate on small plots with modest incomes. Their access to agricultural information is largely informal, relying heavily on agro-input dealers and peer networks, while formal extension services remain underutilized.

Awareness of released varieties is highest for UMUCASS 36 and 37, reflecting the impact of sustained promotion and longer market presence. In contrast, newer varieties suffer from limited exposure, underscoring the need for targeted dissemination efforts. Farmers' perceptions are strongly aligned with practical benefits high yield, suitability for yellow gari, and low HCN content highlighting their dual priorities of food security and marketability. Statistical tests confirmed that education and income significantly

influence both awareness and perception, validating the rejection of the null hypotheses. To enhance adoption, extension strategies must be context-sensitive, leveraging trusted local channels and tailoring messaging to farmers' literacy levels and financial capacities. By addressing these socio-economic determinants, stakeholders can accelerate the diffusion of bio-fortified cassava and contribute meaningfully to nutritional security and agricultural resilience in the region.

4,2 Recommendations

1. Government should partner with agro-input dealers and farmer groups to roll out targeted information drives for newer varieties.
2. Design literacy-sensitive extension materials (audio-visuals, local-language radio) to raise awareness among less-educated farmers.
3. Incorporate positive trait demonstrations high yield, gari-making, low HCN in farmer field days to reinforce favorable perceptions.
4. Conduct segmented campaigns focusing on lower-income and less-experienced farmers to close awareness gaps.

Adapted from BNARDA (2022)

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