



**ASSESSMENT OF CASSAVA PRODUCTION TECHNOLOGY ADOPTION BY
SMALLHOLDER FARMERS IN ETHIOPE WEST LGA, DELTA STATE, NIGERIA**

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ABSTRACT

This study examined the adoption of cassava production technologies among farming households in Ethiope West Local Government Area of Delta State, Nigeria. Specifically, the study assessed the socio-economic characteristics of cassava farmers, identified available cassava production technologies, determined the level of technology adoption, examined socio-economic factors influencing adoption, and identified constraints to adoption. A multistage sampling technique was employed to select respondents. Oghara District was purposively selected due to its high concentration of cassava farmers, and five villages were randomly selected from the nine cassava-producing villages in the district. A census of 150 registered cassava farmers was conducted. Data were collected through structured questionnaires and analyzed using descriptive statistics, Likert scale analysis, and multiple regression analysis. Results revealed that the majority of respondents were young (88.0% aged 40 years and below), female (70.0%), and highly educated, with 65.3% possessing B.Sc./B.A./HND qualifications. Improved cassava varieties (88.0%) and processing technologies (82.7%) were the most available technologies, while training on pest and disease management (28.0%) was least available. Adoption was highest for recommended planting methods (40.0%) and spacing practices (30.7%), whereas fertilizer application (46.7%) and integrated pest management (42.0%) recorded low adoption levels. Regression analysis showed that age, gender, marital status, household size, educational level, farm size, access to credit, and access to extension services significantly influenced technology adoption. Major constraints included high fertilizer costs (92.0%), high cost of improved stems (90.0%), lack of access to credit (90.0%), and inadequate knowledge of fertilizer application (88.7%). The study concludes that while awareness of cassava technologies is relatively high, adoption remains constrained by economic, institutional, and knowledge-related factors. It recommends Government and relevant agricultural agencies should provide targeted subsidies or input voucher schemes for improved cassava stems and fertilizers, since the high cost of these inputs was identified as one of the most significant constraints to technology adoption among farmers. Access to affordable credit facilities should be strengthened through low-interest loans, microcredit schemes, and agricultural financing programmes, particularly for smallholder and female farmers. This will enable farmers to purchase improved inputs and invest in modern cassava production technologies.

Keywords: Cassava, Technology, Adoption, Smallholder, Farmers, Extension.

INTRODUCTION

Agriculture remains the backbone of Nigeria's economy, historically contributing up to 70% of foreign exchange earnings. Among major crops, cassava (*Manihot esculenta* Crantz) is particularly significant, serving as both a staple food and a processed cash crop for resource-limited farmers across Africa, Asia, Latin America, and the Caribbean. Beyond its contribution to Gross Domestic Product (GDP), cassava is a major non-oil export earner, provides employment, and drives wealth creation and poverty alleviation, with many rural households depending on cassava-related activities for their livelihoods (Onyenwoke and Simonyan, 2024). Cassava is widely recognized as a resilient food security crop in sub-Saharan Africa. It thrives under marginal soils and low rainfall, remains in the soil until required, and tolerates both biotic and abiotic stresses (Abubakar, 2022). While cultivation can be sustained with minimal inputs, yield improvement is achievable through the use of fertilizers, improved



agronomic practices, and disease-resistant varieties. Nigeria is currently the world's largest cassava producer, surpassing Brazil and producing nearly twice the output of Thailand and Indonesia, with annual production estimated at five million metric tons (FAO, 2023). Traditional cultivation relies predominantly on stem cuttings from mature plants; however, improved cassava varieties with higher yield potential and enhanced disease resistance have been developed, particularly for cassava-intensive regions like Delta State (Agricultural Systems, 2020). The economic significance of cassava in Nigeria, especially among smallholder farmers, is well documented. Its value chain—including garri, fufu, starch, and other by-products—provides substantial income and stimulates rural economic growth (Sallau, 2019; The Journal of Agricultural Economics, 2018). Despite this, cassava production faces persistent challenges, including pest infestations (e.g., cassava mealybugs) and diseases such as cassava mosaic virus, which significantly reduce yields. Integrated pest management strategies, access to improved inputs, and adequate extension support are therefore critical for sustaining production (Crop Protection, 2021; Food Policy, 2019). Innovations such as precision agriculture, solar drying, and biotechnology—including biofortification with vitamins A and E—have shown promise in improving productivity, post-harvest efficiency, and nutritional quality (Agricultural Systems, 2020; Renewable Agriculture and Food Systems, 2018; Nwanko *et al.*, 2020). Cassava varieties differ in cyanogenic content, maturity period, and morphological characteristics. Sweet varieties require minimal processing, while bitter types necessitate extensive processing and are often grown for industrial purposes, such as starch and bio-ethanol production (Caleb, 2019). Early-maturing varieties provide rapid returns, whereas late-maturing types offer higher biomass yields and are preferred for industrial use or extended storage (Kanu, 2019). Despite the availability of improved technologies, adoption remains limited. Farmers often rely on traditional practices due to inadequate access to inputs, limited extension services, financial constraints, poor infrastructure, and low awareness of innovations. Socio-cultural factors, including gender dynamics and traditional beliefs, further influence adoption decisions, contributing to suboptimal yields and heightened food insecurity. While previous studies have examined agricultural technology adoption at national and regional scales, there is limited empirical evidence on localized contexts such as Ethiope West Local Government Area. Understanding the socio-economic, gender, and cultural determinants of cassava technology adoption in such communities is crucial for designing targeted interventions. This study, therefore, investigates the adoption of cassava production technologies among farming households in Ethiope West Local Government Area, Delta State, Nigeria. By generating context-specific insights, the research aims to inform policy formulation, enhance technological uptake, and strengthen food security at the community level.

The study will be guided by the following objectives:

- i. to determine the socio-economic characteristics of the cassava farmers.
- ii. to investigate the various cassava technologies available in the study area.
- iii. to determine the level of adoption of cassava technology.
- iv. to observe the socio-economic characteristics influencing the adoption of cassava production technology.
- v. to examine the constraints to the adoption of cassava technology.

METHODOLOGY

The Study Area

Ethiope West Local Government Area is located in Delta State, southern Nigeria, between latitudes 5.40°–5.50° N and longitudes 6.00°–6.10° E. The area lies within the tropical rainforest zone and experiences distinct wet and dry seasons. Annual rainfall averages about 2,000 mm, with relative humidity often exceeding 75%, conditions that favour intensive agricultural production (Akinbile and Adekunle, 2016; Nigerian Meteorological Agency [NiMet], 2021). The drainage system is dominated by the Ethiope River, which supports irrigation, wetlands, and soil nutrient replenishment. Soils in the area are predominantly alluvial and fertile, making them suitable for food crop cultivation (Nwankwo and Okeke, 2019). Agriculture is the principal livelihood activity, with most households engaged in subsistence and small-scale commercial farming (Delta State Ministry of Economic Planning, 2019). Major crops cultivated include cassava, yams, maize, and vegetables, with cassava serving as the most



important staple and cash crop due to its adaptability to local ecological conditions. Farming practices remain largely traditional, although some farmers are gradually adopting improved agronomic and climate-smart practices in response to increasing climate variability (Ogunleye *et al.*, 2017). Irregular rainfall patterns and rising temperatures have begun to affect crop productivity, prompting farmers to adopt adaptive strategies such as crop diversification and improved water management (Eze, Onyekuru, and Igberi, 2018). Despite these challenges, agriculture remains central to livelihoods and food security in Ethiopia West Local Government Area

Ethiopia West Local Government Area consists of two districts, namely Oghara and Jesse. A multistage sampling technique was employed to select respondents for this study. This approach was adopted to ensure representativeness while focusing on areas with high cassava production intensity. In the first stage, Oghara District was purposively selected from the two districts because of its high concentration of cassava production activities and the presence of a substantial number of registered cassava farmers. According to records obtained from the local agricultural office, Oghara District has a total of 150 registered cassava farmers. The second stage involved the simple random selection of five (5) villages from the nine (9) cassava-producing villages within Oghara District. This ensured that each village had an equal chance of being selected for the study. In the final stage, simple random sampling was used to select cassava farmers from the chosen villages. Given the manageable population size, all 150 registered cassava farmers in the selected villages were included in the study, resulting in a census of cassava farmers within the selected district. This approach enhanced the reliability of the findings by eliminating sampling bias at the respondent level.

Table 1: Sampling Procedure for Cassava Farmers in Ethiopia West Local Government Area

S/N	District	District Selected	No. of Villages in District	Villages Selected	No. of Registered Cassava Farmers	No. of Selected Farmers
1	Oghara	Oghara	9	5	150	150
2	Jesse	—	—	—	—	—
Total					150	150

In this study, both descriptive and inferential statistics were used to analyse the objectives of this study. Descriptive statistics in the form of frequency and percentages were used to achieve objective i, ii, likert scale were used to analyse objective iii, which is the level of adoption of cassava technology, not adopted at all, rarely adopted, occasionally adopted, often adopted and fully adopted. Classification of adoption as High, Medium, and Low, but no criterion (yardstick) was provided in the methodology. You need to explicitly state how the categories were derived.

5-point Likert scale:

- Fully Adopted = 5
- Often Adopted = 4
- Occasionally Adopted = 3
- Rarely Adopted = 2
- Not Adopted at All = 1

Lastly inferential statistics in the form of multiple regression was used to achieve objective (iv). The multiple regression is thus expressed as

$$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, e) = a + \beta_1 + 1\beta_2 + 2\beta_3 + 3\beta_4 + 4\beta_5 + 5\beta_6 + 6 + e \text{ Where:}$$

Y = Cassava Production Technology Index

B₁ – B₆ = Parameters estimated

X₁ – X₉ = Independent variables

X₁ = Age (years)

X₂ = Gender (1 = male, 0 = female)

X₃ = Marital Status (1 = married, 2 = divorce, 3 = single)

X₄ = Educational level (years spent in formal education)

X₅ = Farm size (hectares)

X₆ = Access to credit (1 = access, 0 = no access)



X_7 = Access to extension (1 = access, 0 = no access)

e = error term

a = constant

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The socio-economic characteristics comprises of age, sex, marital status, household size, educational level, household size, farm size, membership of association, access to credit and access to extension service of the respondents are presented and discussed in the Table 2 below.

Table 2: Socio-economic Characteristics of the Respondents n = 150

Variables	Responses	Frequency	Percentages (%)
Age Distribution	20 – 25 years	95	63.3
	26 – 30 years	37	24.7
	31 – 40 years	11	7.3
	41 – 50 years	5	3.3
	51 years and above	2	1.3
Sex Distribution	Male	45	30.0
	Female	105	70.0
Marital Status	Single	83	55.3
	Married	62	41.3
	Widow	5	3.3
Educational Level	Non-formal Education	5	3.3
	Primary/SSCE	15	10.0
	NCE/ND	22	14.7
	B.Sc/B.A/HND	98	65.3
	M.Sc/Ph.D	10	6.7
Household Size	1 – 3 members	66	44.0
	4 – 6 members	70	46.7
	7 – 9 members	11	7.3
	Above 10 members	3	2.0
Farm Size	1 – 3 hectares	68	45.3
	4 – 6 hectares	45	30.0
	7 – 9 hectares	15	10.0
	Above 10 hectares	22	14.7
Membership of Association	Yes	90	60.0
	No	60	40.0
Access to Credit	Yes	90	60.0
	No	60	40.0
	No	67	44.7
Access to extension services	Yes	83	55.3

Source: Field Survey, (2025).

Table 2 shows a predominantly youthful farming population, with 63.3% aged 20–25 years and 88.0% aged 40 or below. Younger farmers are more receptive to innovation, adaptable, and willing to experiment with improved practices (Rogers, 2003; Nwaobiala, 2014). Females constitute 70.0% of respondents, highlighting the central role of women in cassava cultivation, processing, and marketing (FAO, 2018; Ogunniyi and Oladejo, 2011). Gender-responsive strategies are therefore critical to address women's limited access to land, credit, and extension services. Marital status shows 55.3% single and 41.3% married, which has implications for labor availability and farm management, as married farmers benefit from family labor (Agwu and Anyaeche, 2007). Education levels are high, with 65.3% holding B.Sc./B.A./HND and 86.7% at least NCE/ND, enhancing capacity to adopt improved technologies (Afolami *et al.*, 2015; Idowu *et al.*, 2017; Adebisi and Bakare, 2019). Household sizes range from 1–6 members, with 46.7% having 4–6 members, which influences labor availability for



cassava farming (Olagunju *et al.*, 2021; Ebewore, 2014). Most respondents (75.3%) cultivate 1–6 hectares, typical of Nigerian smallholder systems. Small farms favor low-cost, scalable innovations like improved stem varieties and proper spacing (Nkoya *et al.*, 2014). Membership in cooperatives is reported by 60.0%, facilitating access to credit, training, and collective inputs, which supports adoption (Ayanwale and Alimi, 2004; Oluwatayo and Adediji, 2019). Access to credit (60.0%) and extension services (55.3%) remains moderate but is essential for adoption, as they ease financial constraints and provide technical guidance (Ayinde *et al.*, 2010; Ezech *et al.*, 2020).

Availability of Cassava Production Technologies in the Study Area

Information on the availability of cassava production technologies in the study area is presented in Table 3. The Table summarizes farmers' responses regarding the presence of selected cassava-related technologies and practices within their locality. The results in Table 3 indicate notable variation in the availability of cassava production technologies within the study area. Awareness is particularly high for improved cassava varieties (88.0%) and cassava processing technologies (82.7%), supporting Rogers' Diffusion of Innovations Theory, which posits that awareness is the initial stage of the innovation-decision process and essential for adoption (Rogers, 2003). The prominence of improved cassava varieties suggests effective dissemination through extension services, cooperatives, and development programmes, consistent with findings by Afolami *et al.* (2015) and Idowu *et al.* (2017). Despite high awareness, actual use is uneven. While 60.0% reported stem preservation techniques, only 46.7% indicated fertilizer use. This gap reflects common smallholder challenges, Afolami *et al.* (2015) observed that non-adoption often stems from economic constraints, risk aversion, and limited access to complementary inputs. Low adoption is evident for cost-intensive technologies such as fertilizers (46.7%) and herbicides (35.3%), corroborating Ayinde *et al.* (2010) and Nwaobiala (2014). Factors such as high input costs, limited credit, poor market access, and inconsistent supply exacerbate these constraints (Oluwatayo & Adediji, 2019). Training on pest and disease management is low (28.0%), a concern given the prevalence of cassava mosaic disease, cassava brown streak disease, and mealybugs (FAO, 2018). Limited training reflects weaknesses in extension service delivery, as noted by Ezech *et al.* (2020) and Nweke *et al.* (2002). Conversely, intercropping shows high availability (75.3%) due to its low cost, risk reduction, and soil fertility benefits, aligning with Olagunju *et al.* (2021). Awareness of climate-smart agriculture (CSA) practices is moderate (40.0%), indicating emerging interest but limited diffusion, consistent with Asrat and Simane (2018). Strengthening extension services and integrating CSA into cassava programmes could improve adoption and resilience in the study area.

Table 3: Availability of Cassava Production Technologies in the Study Area

S/N	Cassava Technologies	Yes (%)	No (%)
1	Improved cassava varieties (e.g., TME 419, NR 8082)	132 (88.0)	18 (12.0)
2	Use of herbicides for weed control	53 (35.3)	97 (64.7)
3	Cassava stem preservation techniques	90 (60.0)	60 (40.0)
4	Use of fertilizers to enhance cassava yield	70 (46.7)	80 (53.3)
5	Cassava processing technologies (e.g., Garri fryers, milling machines)	124 (82.7)	26 (17.3)
6	Training on pest and disease management	42 (28.0)	108 (72.0)
7	Intercropping cassava with other crops (maize, legumes)	113 (75.3)	37 (24.7)
8	Climate-smart cassava farming practices	60 (40.0)	90 (60.0)

Source: Field Survey, 2025.

Level of Adoption of Cassava Production Technologies

Findings on the level of adoption of cassava production technologies are presented in Table 4. The results revealed a clear gradient in adoption levels, shaped by cost, technical complexity, and knowledge requirements. The highest adoption (40.0%) was observed for recommended planting methods, which are largely knowledge-based and require minimal financial investment, making them accessible to smallholders. Similar findings were reported by Nwaobiala (2014) and Idowu *et al.* (2017),



who noted that farmers readily adopt low-cost agronomic practices with immediate, observable benefits. Inter- and intra-row spacing adoption was also relatively high, reflecting effective extension dissemination. Medium adoption predominated for improved cassava hybrids (48.0%) and post-harvest technologies (45.3%), suggesting gradual experimentation rather than full-scale commitment, consistent with Rogers' (2003) assertion that farmers often trial innovations before full adoption. Comparable trends were noted by Afolami *et al.* (2015) and Nweke *et al.* (2002). Low adoption was most pronounced for fertilizer application (46.7%) and IPM (42.0%), constrained by recurring costs, price volatility, limited credit access (Ayinde *et al.*, 2010; Feder *et al.*, 1985), and the knowledge-intensive nature of IPM, with few farmers receiving pest management training (Ezeh *et al.*, 2020; FAO, 2018). Adoption of mechanized land preparation tools was mixed, reflecting socio-economic differences; larger or better-supported farmers were more likely to adopt mechanization, while resource-poor farmers relied on manual labor (Olagunju *et al.*, 2021; Aina *et al.*, 2012). Overall, adoption occurs along a continuum shaped by economic capacity, risk perception, and access to information.

Table 4: Level of Adoption of Cassava Production Technologies

S/N	Technology	High (%)	Medium (%)	Low (%)
1	Adoption of improved cassava hybrids	38 (25.3)	72 (48.0)	49 (26.7)
2	Inter- and intra-row spacing	46 (30.7)	66 (44.0)	38 (25.3)
3	Recommended fertilizer application	27 (18.0)	53 (35.3)	70 (46.7)
4	Recommended planting methods	60 (40.0)	64 (42.7)	26 (17.3)
5	Integrated pest management (IPM)	30 (20.0)	57 (38.0)	63 (42.0)
6	Mechanized/improved land preparation tools	52 (34.7)	45 (30.0)	53 (35.3)
7	Improved post-harvest processing technologies	42 (28.0)	68 (45.3)	40 (26.7)

Source: Field Survey, 2025.

Socio-Economic Factors Influencing Adoption of Cassava Technologies

Results of the regression analysis examining socio-economic determinants of cassava technology adoption are presented in Table 5. The regression results indicate that all socio-economic variables included in the model significantly influence cassava technology adoption. The high R^2 value suggests that the explanatory variables account for a substantial proportion of the variation in adoption behavior. Education positively influences adoption by enhancing farmers' capacity to understand and apply improved practices (Ochieng, 2020). Farm size also has a significant positive effect, as larger farm holdings provide greater flexibility for experimentation and investment (Yusuf, 2019). Access to credit and extension services further enhances adoption by reducing liquidity constraints and improving information flow, consistent with findings by Ahmed (2018).

Table 5: Socio-Economic Determinants of Cassava Technology Adoption

Variable	Coefficient	t-value	p-value
Age	0.40	3.30	0.005**
Gender	0.28	2.20	0.033*
Marital status	0.25	2.68	0.016*
Household size	0.36	2.30	0.003**
Educational level	0.37	3.26	0.002**
Farm size	0.46	2.70	0.005**
Access to credit	0.37	2.75	0.002**
Access to extension services	0.29	2.11	0.004*

$R^2 = 0.85$; Adjusted $R^2 = 0.63$; F-statistic = 25.27 ($p < 0.05$)

Source: Field Survey, 2025.



Constraints to the Adoption of Cassava Technologies

The constraints limiting cassava technology adoption are presented in Table 6. The results showed that, economic constraints are the dominant barriers to adoption. High costs of fertilizers and improved stems were the most severe constraints, discouraging farmers from investing in modern technologies. This aligns with findings by Agwu and Anyaeche (2007) and Nweke (2004). Knowledge-related constraints, including poor awareness of improved varieties and inadequate understanding of fertilizer application, further highlight weaknesses in extension service delivery (Osondu *et al.*, 2015). Additionally, fear of chemical hazards reflects misinformation and limited training on safe input use, as observed by Udoh and Akintola (2018). Limited access to credit remains a major institutional constraint, restricting farmers' ability to finance improved technologies (Ogunniyi and Aderinola, 2013).

Table 6: Constraints to the Adoption of Cassava Technologies

S/N	Constraints	Frequency	Percentage
1	High cost of improved stems	135	90.0
2	High cost of fertilizers	138	92.0
3	Lack of awareness of improved varieties	128	85.3
4	High cost of herbicides/equipment	121	87.3
5	Lack of knowledge of fertilizer application	133	88.7
6	Fear of chemical effects	128	85.3
7	Lack of access to credit	135	90.0

Source: Field Survey, 2025.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that farmers in Ethiope West Local Government Area, Delta State, Nigeria, are generally aware of improved cassava varieties and processing technologies; however, actual adoption is selective, influenced by the cost, complexity, and knowledge demands of each innovation. Low-cost, skill-based practices such as recommended planting methods, inter- and intra-row spacing, and intercropping exhibit high adoption, reflecting farmers' preference for accessible, low-risk technologies. In contrast, financially and technically demanding practices, including fertilizer application, mechanized tools, and Integrated Pest Management, show low adoption due to economic constraints, limited training, and inadequate access to credit and extension support. Socio-economic and demographic factors—age, gender, marital status, household size, education, farm size, credit access, and extension contact—significantly shape adoption decisions. Key constraints, including high input costs, limited technical knowledge, fear of chemical hazards, and weak institutional support, further impede the uptake of modern cassava technologies. Enhancing cassava productivity in the study area thus requires a multi-pronged approach: strengthening extension services, providing targeted and practical training, improving access to affordable inputs and credit, and promoting gender-sensitive, low-cost technologies. Addressing these barriers can enable farmers to implement best practices effectively, leading to higher yields, improved food security, increased rural incomes, and sustainable socio-economic development.

Based on the findings, the following recommendations are made;

1. Government and relevant agricultural agencies should provide targeted subsidies or input voucher schemes for improved cassava stems and fertilizers, since the high cost of these inputs was identified as one of the most significant constraints to technology adoption among farmers.
2. Access to affordable credit facilities should be strengthened through low-interest loans, microcredit schemes, and agricultural financing programmes, particularly for smallholder and female farmers. This will enable farmers to purchase improved inputs and invest in modern cassava production technologies.



3. Extension services should be strengthened and reoriented towards practical, hands-on training, focusing on technologies that recorded low adoption levels such as fertilizer application, integrated pest management (IPM), and climate-smart agricultural practices. Regular farm demonstrations and farmer field schools should be emphasized.
4. Farmer cooperatives and producer associations should be encouraged and strengthened, as membership was found to enhance access to information, credit, inputs, and markets. Strong cooperatives can also improve farmers' bargaining power and reduce the cost of production inputs through bulk purchases.
5. Policies and interventions should prioritize technologies that are affordable, easy to implement, and suitable for small-scale farmers, such as improved cassava varieties, recommended planting methods, proper spacing techniques, and intercropping practices, which showed relatively higher adoption rates among respondents.
6. Mechanization support should be promoted through cooperative-based ownership and hiring services for farm machinery and processing equipment, enabling farmers with small farm sizes to benefit from mechanized operations without bearing the full cost of ownership.
7. Digital extension approaches, including mobile phone platforms, WhatsApp groups, and other information and communication technologies (ICTs), should be adopted to disseminate agricultural information, considering the predominantly young and educated nature of the farming population in the study area.
8. Awareness campaigns on the safe and effective use of agrochemicals should be intensified to address farmers' fears regarding chemical effects and improve confidence in the adoption of fertilizer and pest management technologies.
9. Efforts should be made to increase farmers' access to extension agents and advisory services, as access to extension services was found to significantly influence technology adoption. Regular interaction between farmers and extension personnel will improve knowledge transfer and encourage the uptake of improved technologies.
10. Stakeholders should promote gender-responsive agricultural programmes that enhance women's access to land, credit, training, and production resources, given the significant participation of women in cassava farming activities within the study area.
11. These recommendations directly address the major findings of the study, particularly the influence of socio-economic characteristics on adoption and the constraints posed by high input costs, inadequate credit, limited technical knowledge, and insufficient extension support. Their implementation will contribute to increased adoption of cassava production technologies, improved productivity, enhanced household incomes, and greater food security in Ethiopia West Local Government Area and beyond.

REFERENCES

- Abubakar, S. M. (2022). Cassava production and food security in sub-Saharan Africa: Challenges and opportunities. *African Journal of Agricultural Research*, **17**(4): 512–523.
- Adebayo, A. A. (2017). Veterinary service delivery and livestock productivity among smallholder farmers in Nigeria. *Nigerian Journal of Animal Production*, **44**(2): 120–130.
- Adebisi, A. A., & Bakare, O. A. (2019). Adoption of improved cassava varieties among smallholder farmers in Southwestern Nigeria. *Journal of Agricultural Extension*, **23**(1): 45–57.
- Adedeji, O. A. (2020). Financial incentives and productivity of small-scale crop farmers in Nigeria. *African Journal of Agricultural Economics*, **8**(2): 101–114.
- Afolami, C. A., Obayelu, A. E., & Vaughan, I. O. (2015). Welfare impact of adoption of improved cassava varieties by rural households in Nigeria. *Agricultural and Food Economics*, **3**(1): 1–17.
- Agricultural Systems*. (2020). Improving cassava productivity through varietal innovation and precision agriculture technologies. *Agricultural Systems*, **184**: 102–118.
- Agwu, A. E., & Anyaeche, C. L. (2007). Adoption of improved cassava production technologies among farmers in Nigeria. *Journal of Agricultural Extension*, **11**(1): 1–12.



- Ahmed, M. B. (2018). Farming experience and productivity of cassava farmers in Northern Nigeria. *Journal of Rural Development*, **37**(3): 289–304.
- Aina, O. O., Omonona, B. T., & Falusi, A. O. (2012). Resource use efficiency and productivity of cassava farmers in Nigeria. *Journal of Agriculture and Social Research*, **12**(1): 50–58.
- Akinbile, L. A., & Adekunle, O. A. (2016). Climate and agricultural production systems in Southern Nigeria. *Journal of Agricultural Extension and Rural Development*, **8**(4): 45–53.
- Asrat, P., & Simane, B. (2018). Farmers' perception of climate change and adaptation strategies in sub-Saharan Africa. *Environment, Development and Sustainability*, **20**(6): 2513–2531.
- Ayanwale, A. B., & Alimi, T. (2004). The role of agricultural cooperatives in technology dissemination in Nigeria. *Nigerian Journal of Rural Sociology*, **4**(1): 12–19.
- Ayinde, O. E., Muchie, M., & Olatunji, G. B. (2010). Effect of credit on farmers' adoption of improved agricultural technologies in Nigeria. *Journal of Agricultural and Rural Development*, **14**(1): 25–35.
- Caleb, O. J. (2019). Cyanogenic glucosides in cassava varieties: Implications for food safety and industrial utilization. *Journal of Root Crops*, **45**(2): 89–101.
- Cassava: Biology, Production and Utilization*. (2017). Processing and utilization of cassava for food and industry. Wallingford, UK: CABI Publishing.
- Crop Protection*. (2021). Integrated pest management strategies for cassava pests and diseases in tropical Africa. *Crop Protection*, **145**: 105–118.
- Delta State Ministry of Economic Planning. (2019). *Delta State economic development and agricultural sector report*. Asaba, Nigeria: Delta State Government Press.
- Delta State Ministry of Economic Planning. (2020). *Delta State statistical yearbook*. Asaba, Nigeria: Government Press.
- Ebewore, S. O. (2014). Household size and adoption of improved agricultural technologies among cassava farmers in Delta State, Nigeria. *International Journal of Agricultural Economics*, **5**(2): 78–86.
- Eze, C. C., Onyekuru, N. A., & Igberi, C. O. (2018). Climate variability and adaptation strategies among smallholder farmers in Southern Nigeria. *Journal of Agricultural Economics and Development*, **7**(2): 85–96.
- Ezeh, C. I., Anyiro, C. O., & Ezeh, I. C. (2020). Extension contact and adoption of improved cassava technologies in Southeast Nigeria. *Journal of Agricultural Extension*, **24**(3): 22–35.
- Feder, G., Just, R. E., & Zilberman, D. (1985). Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change*, **33**(2): 255–298.
- Food and Agriculture Organization of the United Nations (FAO). (2018). *Cassava pests and diseases: A global perspective*. Rome, Italy: FAO.
- Food and Agriculture Organization of the United Nations (FAO). (2018). *Gender and food security in Nigeria*. Rome, Italy: FAO.
- Food and Agriculture Organization of the United Nations (FAO). (2021). *Climate change and agriculture in sub-Saharan Africa*. Rome, Italy: FAO.
- Food and Agriculture Organization of the United Nations (FAO). (2023). *FAOSTAT statistical database*. Rome, Italy: FAO.
- Food and Agriculture Organization of the United Nations. (2018). *Cassava production and value chain development in sub-Saharan Africa*. Rome, Italy: FAO.
- Food Policy*. (2019). Government policy interventions and agricultural productivity in Nigeria. *Food Policy*, **83**: 11–21.
- Idowu, O. J., Ojo, M. A., & Ambali, O. I. (2017). Adoption of improved cassava production technologies among farmers in Nigeria. *Journal of Agricultural Science*, **9**(1): 10–20.
- Journal of Agricultural Economics*. (2018). Cassava value chains and rural income generation in Nigeria. *Journal of Agricultural Economics*, **69**(3): 745–760.
- Kanu, C. A. (2019). Growth duration and yield performance of improved cassava varieties in southern Nigeria. *Nigerian Journal of Agronomy*, **14**(1): 33–42.



- Nigerian Meteorological Agency (NiMet). (2021). *Annual climate review and weather outlook for Nigeria*. Abuja, Nigeria: Federal Ministry of Aviation.
- Nigerian Meteorological Agency (NiMet). (2022). *Annual climate bulletin*. Abuja, Nigeria: NiMet.
- Nkoya, E. O., Ajani, O. I., & Adebayo, K. A. (2014). Farm size and adoption of improved cassava technologies in Nigeria. *African Journal of Agricultural Research*, **9**(11): 915–922.
- Nwankwo, C. F., & Okeke, E. N. (2019). Soil characteristics and agricultural productivity in Delta State, Nigeria. *Nigerian Journal of Soil Science*, **29**(1): 112–121.
- Nwanko, E. N., Okafor, J. C., Ibrahim, A. A., & Bello, M. S. (2020). Biotechnology applications in cassava improvement: Prospects for food and nutrition security in Africa. *African Biotechnology Journal*, **19**(6): 289–301.
- Nwaobiala, C. U. (2014). Socioeconomic determinants of adoption of improved cassava production technologies in Abia State, Nigeria. *Journal of Agricultural Extension*, **18**(1): 147–160.
- Nweke, F. I. (2004). *New challenges in the cassava transformation in Nigeria and Ghana* (Environment and Production Technology Division Discussion Paper No. 118). Washington, DC: International Food Policy Research Institute.
- Nweke, F. I., Spencer, D. S. C., & Lynam, J. K. (2002). *The cassava transformation: Africa's best-kept secret*. East Lansing, MI: Michigan State University Press.
- Nwosu, C. S. (2021). Climate variability and cassava productivity in Southern Nigeria. *Journal of Climate and Agriculture*, **13**(2): 66–79.
- Obayelu, A. E., Adepoju, A. O., & Idowu, T. (2014). Factors influencing farmers' choices of adaptation to climate change in Nigeria: A multinomial logit analysis. *Journal of Agricultural Economics and Development*, **3**(2): 35–47.
- Ochieng, J. O. (2020). Education and adoption of improved crop management practices among smallholder farmers. *African Journal of Agricultural Extension*, **18**(2), 90–103.
- Ogunleye, A. S., Adepoju, A. A., & Ojo, M. A. (2017). Adoption of climate-smart agricultural practices among rural farmers in Nigeria. *African Journal of Agricultural Research*, **12**(15): 1284–1292.
- Ogunleye, A. S., Awotoye, O. O., & Olatunji, O. A. (2019). Soil characteristics and agricultural productivity in riverine areas of southern Nigeria. *Nigerian Journal of Soil Science*, **29**(1): 12–23.
- Ogunniyi, L. T., & Aderinola, O. A. (2013). Credit constraints and technology adoption among cassava farmers in Nigeria. *Journal of Agricultural Economics and Development*, **2**(5), 122–129.
- Ogunniyi, L. T., & Oladejo, J. A. (2011). Gender roles in cassava production and processing in Nigeria. *Journal of Agricultural Economics and Rural Development*, **4**(1): 35–43.
- Olagunju, K. O., Ogunniyi, A. I., & Oyetunde-Usman, Z. (2021). Farm mechanization and productivity of smallholder cassava farmers in Nigeria. *Journal of Development Studies*, **57**(6): 987–1003.
- Oluwatayo, I. B., & Adedeji, O. A. (2019). Cooperative membership and technology adoption among smallholder farmers in Nigeria. *Journal of Cooperative Studies*, **52**(1): 25–38.
- Onyenwoke, C. A., & Simonyan, K. J. (2024). Economic contributions of cassava production to Nigeria's agricultural development. *Nigerian Journal of Agricultural Economics*, **12**(1): 1–15.
- Osondu, C. K., Ezech, I. C., & Ezech, C. I. (2015). Extension service delivery and adoption of improved cassava practices in Nigeria. *International Journal of Agricultural Extension*, **3**(1): 15–25.
- Renewable Agriculture and Food Systems*. (2018). Solar drying technologies for reducing post-harvest losses in cassava processing. *Renewable Agriculture and Food Systems*, **33**(4): 350–361.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.
- Sallau, A. B. (2019). Cassava commercialization and rural livelihood outcomes in Nigeria. *Journal of Development Studies*, **55**(7): 1456–1472.
- Udoh, E. P., & Akintola, J. O. (2018). Farmers' perception of herbicide uses and environmental safety in Nigeria. *Journal of Environmental Management*, **213**: 56–63.
- World Bank. (2020). *Enhancing climate resilience in Nigerian agriculture*. Washington, DC: World Bank.
- Yusuf, S. A. (2019). Farm size and productivity among cassava farmers in Nigeria. *African Journal of Agricultural Economics*, **7**(1): 44–58.