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Determinant of farmers' coping strategies to flood risks in cassava production in the Niger Delta, Nigeria

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Abstract
Flooding represents one of the most significant environmental threats to agricultural production in the Niger Delta region of Nigeria. Smallholder farmers cultivating cassava frequently experience crop losses due to seasonal inundation and prolonged waterlogging. This study analyzed the coping strategies adopted by cassava farmers and examined the socio-economic determinants influencing their adoption decisions in Omoku, Rivers State, Nigeria. Primary data were collected from 120 cassava farmers using structured questionnaires and key informant interviews. Descriptive statistics and a multinomial logit model were used to analyze the data. The results revealed that farmers employed several coping strategies to reduce flood-related crop losses. The most widely adopted strategies were ridging or mounding (76.7%), early harvesting (67.5%), crop diversification (61.7%), and adjustment of planting dates (48.3%). Less frequently adopted measures included farm relocation and construction of drainage channels due to financial constraints. Econometric analysis showed that education level, farm size, access to extension services, and access to credit significantly influenced the adoption of coping strategies at the 5% significance level. Farmers with higher educational attainment and greater institutional support were more likely to adopt multiple adaptation strategies. Major constraints identified included lack of funds, poor drainage infrastructure, limited access to improved cassava varieties, and inadequate extension support. The findings highlight the critical role of institutional and financial resources in strengthening farmers' adaptive capacity to flood risks. The study recommends expansion of extension services, improved access to credit facilities, dissemination of flood-tolerant cassava varieties, and community-based flood management programmes to enhance resilience of cassava farming systems in flood-prone regions of Nigeria.

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1. Introduction

Flood hazards have become increasingly common in tropical agricultural systems due to climate variability and land-use changes (Adelekan, 2016; IPCC, 2022). In sub-Saharan Africa, flood events frequently disrupt crop production, damage infrastructure, and threaten rural livelihoods (Abaje et al., 2014).

The Niger Delta region of Nigeria is particularly vulnerable to flooding because of its low-lying terrain, extensive river systems, and high rainfall intensity (Abam, 2006; Adelekan, 2016). Seasonal flooding often submerges farmlands and destroys crops cultivated by smallholder farmers, thereby undermining rural livelihoods (NIMET, 2023).

Cassava (Manihot esculenta Crantz) remains one of the most important staple crops cultivated in Nigeria. The crop plays a vital role in food security, employment generation, and income diversification for rural households (Nweke et al., 2002; FAO, 2023). However, despite its tolerance

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to drought, cassava is highly sensitive to prolonged flooding and waterlogging conditions that restrict root respiration and increase susceptibility to diseases (Okogbenin et al., 2013; Olanrewaju et al., 2019).

Farmers often respond to climate-related shocks by adopting coping and adaptation strategies aimed at minimizing crop losses and stabilizing household income (Ndamani & Watanabe, 2016). These strategies include ridging or mounding, crop diversification, early harvesting, and adjustment of planting dates.

However, the adoption of such strategies depends largely on farmers' socio-economic characteristics, access to information, institutional support, and financial resources (Abaje et al., 2014; IPCC, 2022).

Despite increasing flood frequency in the Niger Delta, empirical studies examining determinants of coping strategy adoption among cassava farmers remain limited. Therefore, this study investigates the coping strategies used by cassava farmers and identifies the socio-economic factors influencing their adoption in Omoku, Rivers State, Nigeria.

2. Method

2.1. Study Area

The study was conducted in Omoku, located in the Niger Delta region of Nigeria. The area experiences high rainfall and frequent flooding due to its low elevation and proximity to major rivers. Agriculture is the primary livelihood activity in the region, and cassava is the dominant crop cultivated by smallholder farmers.

2.2. Research Design

A cross-sectional survey research design was employed to evaluate farmers' coping strategies and the socio-economic factors influencing their adoption. This design enabled the collection of data from farmers regarding their responses to flood events during recent farming seasons.

2.3. Sampling Procedure

A multi-stage sampling technique was used:

1. Flood-prone communities were purposively selected.
2. Villages were randomly selected within these communities.
3. Cassava farmers were selected using systematic sampling techniques.

A total of 120 cassava farmers were surveyed.

2.4. Analytical Framework

To determine the factors influencing farmers' coping strategies, a multinomial logit (MNL) model was employed.

$$P_{ij} = \frac{e^{\beta_j X_i}}{\sum e^{\beta_K X_i}} \quad (1)$$

Where:
P_{ij} = probability that farmer i adopts strategy j
X_i = vector of explanatory variables
β = estimated coefficients

3. Results and Discussion

3.1. Socio-Economic Characteristics of Cassava Farmers

Understanding the socioeconomic characteristics of farmers is essential for interpreting their adaptation behaviour to climate-related hazards such as flooding. The results presented in Table 1 indicate that cassava farming in the study area is predominantly carried out by male farmers, who constitute approximately 65% of the respondents, while female farmers account for about 35%.

Although men often dominate land ownership and farm management decisions, women play critical roles in cassava processing, marketing, and household food security (Howeler et al., 2020; Jarvis et al., 2022).

The age distribution shows that the majority of farmers fall within the 31 - 50 years age group, representing the economically active population. Farmers within this category typically possess greater farming experience and physical capacity to undertake labour-intensive agricultural activities.

Education also plays an important role in farmers' ability to adapt to climate variability. Approximately 36% of respondents had secondary education, which can enhance access to agricultural information and adoption of improved agronomic practices (Abaje et al., 2014; Baffour-Ata et al., 2024).

Access to institutional support was relatively limited. Only 40.8% of farmers reported having contact with extension agents, while access to agricultural credit was even lower. Limited institutional support can constrain farmers' ability to invest in climate-adaptation technologies (Marcus, 2024; Abolade et al., 2025). Socio-economic characteristics of farmers can be seen in Table 1.

Table 1. Socio-Economic Characteristics of Farmers

Variable	Category	Percentage (%)
Gender	Male	65
	Female	35
Age group	31–50 years	53
Education	Secondary education	36
Extension access	Yes	40.8

3.2. Flood Coping Strategies Adopted by Farmers

Farmers in the study area employ a range of coping strategies to mitigate the adverse effects of flooding on cassava production. The distribution of adaptation strategies adopted by farmers is presented in Table 2 and Figure 1.

Ridging or mounding emerged as the most widely adopted coping strategy, practiced by approximately 76.7% of respondents. This strategy involves raising planting beds above ground level to facilitate drainage and reduce waterlogging around cassava roots. Ridging was identified as the most commonly practiced strategy due to its effectiveness in improving soil drainage and reducing waterlogging around cassava roots. which is consistent with previous studies on cassava production in flood-prone environments (Okogbenin et al., 2013; Olanrewaju et al., 2019).

Early harvesting was the second most common strategy, adopted by 67.5% of farmers. This practice allows farmers to harvest cassava before floodwaters inundate their fields. Although early harvesting may reduce yield potential because the crop has not reached full maturity, it helps farmers avoid total crop loss during severe flood events (Ndamani & Watanabe, 2016).

Crop diversification was adopted by approximately 61.7% of farmers. Diversification involves cultivating multiple crops simultaneously to reduce dependence on a single crop. This strategy spreads production risk and enhances household food security during adverse climatic conditions (Pingali et al., 2022; Ayanlade et al., 2023).

Planting date adjustment was practiced by nearly half of the respondents. By modifying planting schedules, farmers attempt to avoid peak flood periods and reduce the risk of crop damage. Planting date adjustment is widely recognized as a low-cost climate adaptation strategy that farmers can implement without significant financial investment (IPCC, 2022).

Less frequently adopted strategies included farm relocation and construction of drainage channels. These practices often require significant financial resources and access to land, which many smallholder farmers lack.

Table 2. Adoption Rates of Coping Strategies

Strategy	Adoption (%)
Ridging or mounding	76.7
Early harvesting	67.5
Crop diversification	61.7
Planting date adjustment	48.3
Farm relocation	24.2

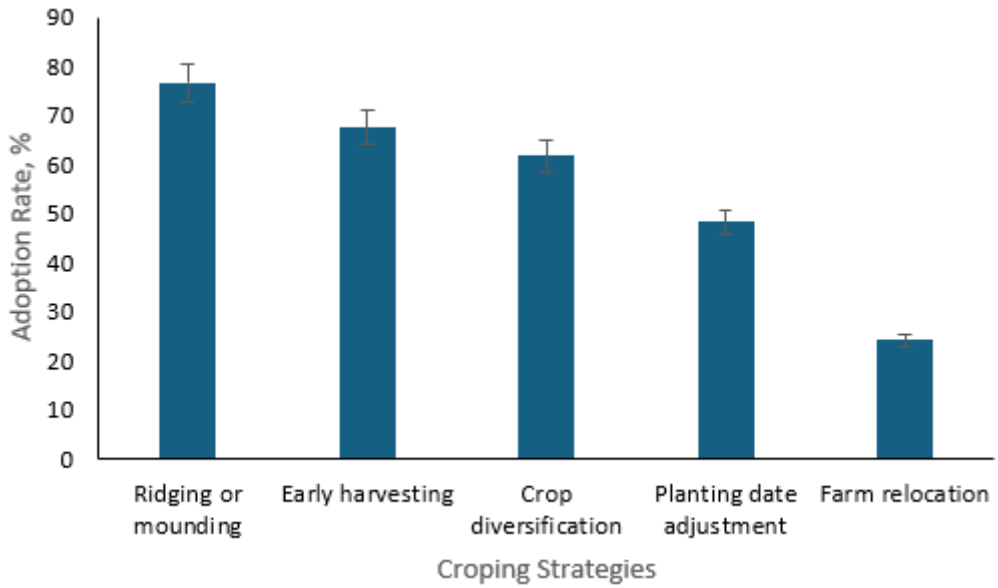

Figure 1. Adoption Rates of Flood Coping Strategies Among Cassava Farmers

3.3. Determinant of Coping Strategy Adoption

To examine the factors influencing farmers' adaptation decisions, a multinomial logit model was estimated. The multinomial logit regression results presented in Table 3 show that several socioeconomic variables significantly influence farmers' adaptation decisions. The results indicate that several socioeconomic and institutional variables significantly influence farmers' coping strategy choices.

Education level emerged as a statistically significant determinant of adaptation strategy adoption ($p < 0.05$). Farmers with higher levels of education were more likely to adopt improved coping strategies. Education enhances farmers' ability to understand climate risks and evaluate alternative agricultural practices (Ogundeji, 2022).

Farm size also exhibited a positive relationship with strategy adoption. Farmers with larger landholdings have greater flexibility to experiment with different management practices and diversify crop production. Larger farms also provide greater resilience to localized climate shocks.

Access to extension services significantly increased the likelihood of adopting coping strategies. Extension agents play a crucial role in disseminating agricultural information and promoting climate-smart farming practices (Emmanuel et al., 2023).

Credit access also had a positive and significant effect on strategy adoption. Farmers with access to financial resources were better able to invest in improved technologies such as drainage systems and flood-tolerant cassava varieties. Financial inclusion therefore plays a crucial role in strengthening agricultural resilience to climate change.

Age showed a negative relationship with strategy adoption, suggesting that younger farmers tend to adopt adaptation strategies more readily than older farmers. This finding aligns with previous research indicating that younger farmers are generally more willing to adopt new technologies and practices (Ogundeji, 2022).

Table 3. Multinomial Logit Regression Results

Variable	Coefficient	Std. Error	z-value	p-value
Age	−0.018	0.007	−2.57	0.010
Education	0.072	0.025	2.88	0.004
Farm Size	0.095	0.031	3.06	0.002
Extension Access	0.841	0.274	3.07	0.002
Credit Access	1.126	0.318	3.54	0.000

3.4. Marginal Effects Analysis

Marginal effects analysis was conducted to evaluate how changes in explanatory variables influence the probability of farmers adopting different flood coping strategies. The results presented in Table 4 indicate that several socioeconomic and institutional variables significantly influence farmers' adaptation behaviour.

The relationship between education and adaptation probability is presented in Table 5 and Figure 2. Education exhibits a positive effect on the probability of adopting flood coping strategies. As the years of formal education increase, the likelihood of farmers implementing improved adaptation practices also rises (Figure 2). Education enhances farmers' access to climate information, improves their capacity to interpret extension advice, and increases their ability to adopt innovative agricultural technologies (Abaje et al., 2014; Ogundeji, 2022). This finding supports earlier studies which show that education plays a crucial role in strengthening farmers' resilience to climate variability and environmental shocks (IPCC, 2022; Baffour-Ata et al., 2024).

Farm size also has a positive influence on the probability of adaptation strategy adoption (Table 6 and Figure 3). Farmers with larger landholdings have greater flexibility to experiment with various risk-management practices such as crop diversification and improved land management techniques. Larger farms also allow farmers to allocate portions of their land to different crops, thereby reducing production risks associated with climate hazards (Pingali et al., 2022).

Institutional variables such as extension services and access to credit also show strong positive effects on farmers' adaptation behaviour (Table 7 and Table 8, Figure 4 and Figure 5). Farmers who maintain contact with extension agents are more likely to adopt improved agricultural practices because extension officers serve as a critical channel for disseminating climate-smart farming techniques and adaptation knowledge (Emmanuel et al., 2023). Similarly, access to credit significantly increases farmers' capacity to invest in capital-intensive adaptation measures such as drainage construction, improved seed varieties, and farm relocation when necessary (Abolade et al., 2025).

Among all explanatory variables, credit access exhibits the largest marginal effect across the adaptation strategies. This suggests that financial resources play a critical role in enabling farmers to implement adaptation measures and reduce vulnerability to flood risks. Previous studies have similarly reported that financial inclusion significantly enhances farmers' capacity to adopt climate adaptation strategies and invest in resilient agricultural systems (Ndamani & Watanabe, 2016; Ayanlade et al., 2023).

Overall, the marginal effects analysis highlights the importance of human capital development and institutional support in improving farmers' adaptive capacity to climate-induced flooding in the Niger Delta region.

Table 4. Predicted Marginal Effects

Variable	Ridging	Early Harvesting	Diversification	Planting Adjustment
Education	0.024	0.018	0.015	0.010
Farm Size	0.031	0.021	0.019	0.013
Extension Access	0.182	0.147	0.126	0.095
Credit Access	0.245	0.188	0.154	0.112

Table 5. Predicted Probability of Adaptation Strategy Adoption as Education Level Increases

Years of Education	Ridging Probability	Early Harvesting	Diversification	Planting Adjustment
0	0.45	0.39	0.36	0.30
3	0.50	0.43	0.40	0.33
6	0.56	0.47	0.44	0.36
9	0.61	0.51	0.48	0.39
12	0.66	0.55	0.52	0.42
15	0.70	0.58	0.55	0.45

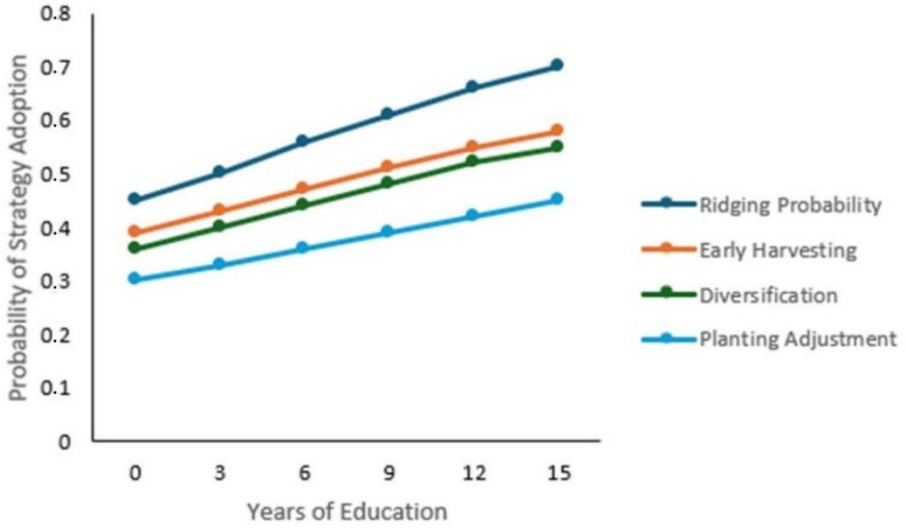

Figure 2. Predicted Probability of Adaptation Strategy Adoption as Education Level Increases

Table 6. Effect of Farm Size on Probability of Coping Strategy Adoption

Farm Size (ha)	Ridging	Early Harvesting	Diversification	Planting Adjustment
0.5	0.46	0.41	0.38	0.31
1.0	0.50	0.44	0.41	0.34
1.5	0.55	0.47	0.45	0.37
2.0	0.59	0.50	0.48	0.39
2.5	0.63	0.53	0.51	0.41
3.0	0.67	0.56	0.54	0.43

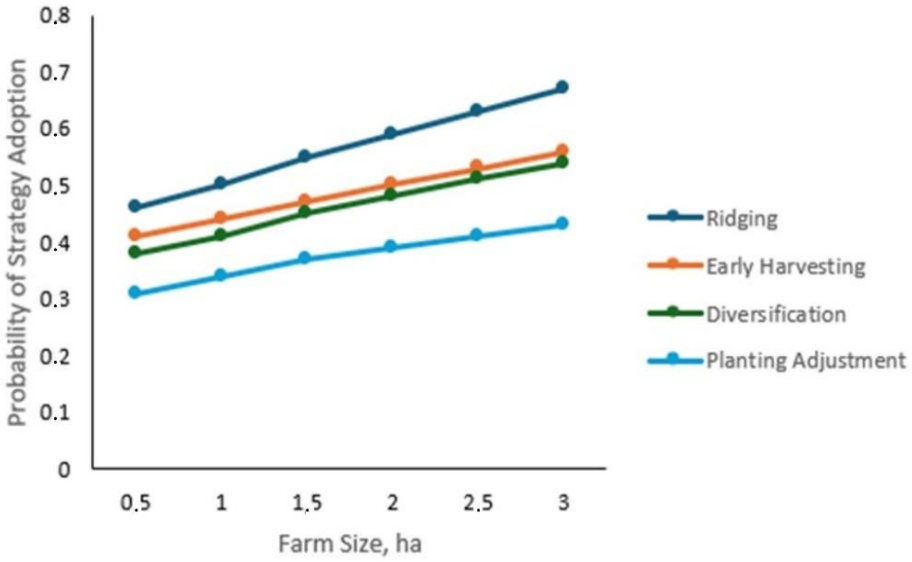

Figure 3. Effect of Farm Size on Probability of Coping Strategy Adoption

Table 7. Influence of Extension Services on Adoption of Coping Strategies

Extension Contact	Ridging	Early Harvesting	Diversification	Planting Adjustment
No	0.41	0.37	0.33	0.28
Yes	0.59	0.52	0.46	0.37

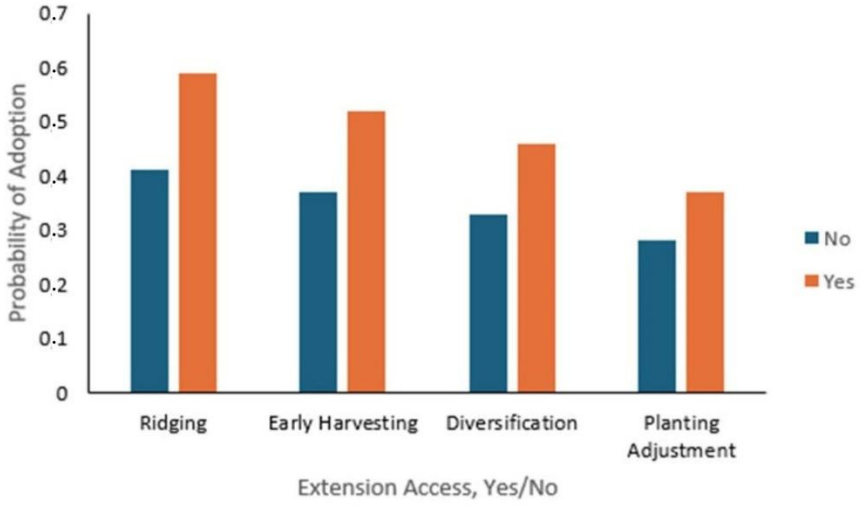

Figure 4. Influence of Extension Services on Adoption Of Coping Strategies

Table 8. Effect of Credit Access on Farmers' Adaptation Behaviour

Credit Access	Ridging	Early Harvesting	Diversification	Planting Adjustment
No	0.38	0.34	0.30	0.25
Yes	0.62	0.53	0.45	0.36

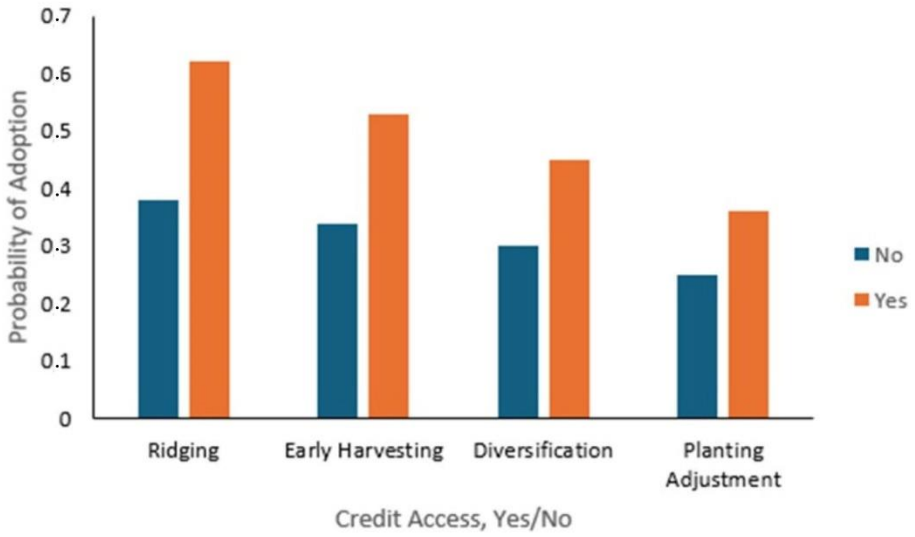

Figure 5. Effect of Credit Access on Farmers' Adaptation Behaviour

3.5. Constraints to Flood Adoption

Despite adopting several coping strategies, farmers in the study area face numerous constraints that limit their ability to effectively adapt to flood risks. The results presented in Table 9 and Figure 6 indicate that financial limitations constitute the most severe barrier to adaptation.

Lack of financial resources was ranked as the most critical constraint affecting farmers' adaptation capacity. Without adequate access to credit or financial support, farmers are unable to invest in essential adaptation measures such as improved drainage systems, flood-tolerant cassava varieties, or relocation of farms to less vulnerable areas. Financial constraints have been widely recognized as a major barrier to climate adaptation among smallholder farmers in developing countries (Ndamani & Watanabe, 2016; Abolade et al., 2025).

Poor drainage infrastructure was identified as the second most significant constraint. The Niger Delta region is characterized by low-lying floodplains and inadequate drainage systems, which make agricultural lands highly susceptible to waterlogging during periods of heavy rainfall. Inadequate drainage infrastructure significantly increases farmers' vulnerability to crop losses and limits the effectiveness of adaptation strategies (Abam, 2006; Adelekan, 2016).

Limited access to improved cassava varieties that are tolerant to flooding was also reported as an important constraint. Although agricultural research institutions have developed improved cassava cultivars with enhanced tolerance to environmental stresses, dissemination of these varieties remains limited in many rural farming communities (Okogbenin et al., 2013). As a result, many farmers continue to rely on traditional cassava varieties that are highly susceptible to flood damage.

Inadequate extension support was also identified as a key barrier to adaptation. Limited contact with extension agents restricts farmers' access to critical agricultural information, training, and technical guidance required for implementing climate-smart farming practices. Extension services play a fundamental role in facilitating knowledge transfer and promoting climate adaptation strategies among rural farming communities (Emmanuel et al., 2023).

These findings underscore the importance of strengthening institutional support mechanisms such as rural credit systems, agricultural extension services, and improved seed distribution programs. Addressing these structural constraints will significantly enhance farmers' capacity to adapt to climate-induced flood risks and sustain cassava production in the Niger Delta region.

Table 9. Ranking of Major Constraints to Flood Adaptation

Constraint	Severity Score	Rank
Lack of funds	4.8	1
Poor drainage infrastructure	4.2	2
Limited access to improved cassava varieties	3.6	3
Inadequate extension support	3.2	4

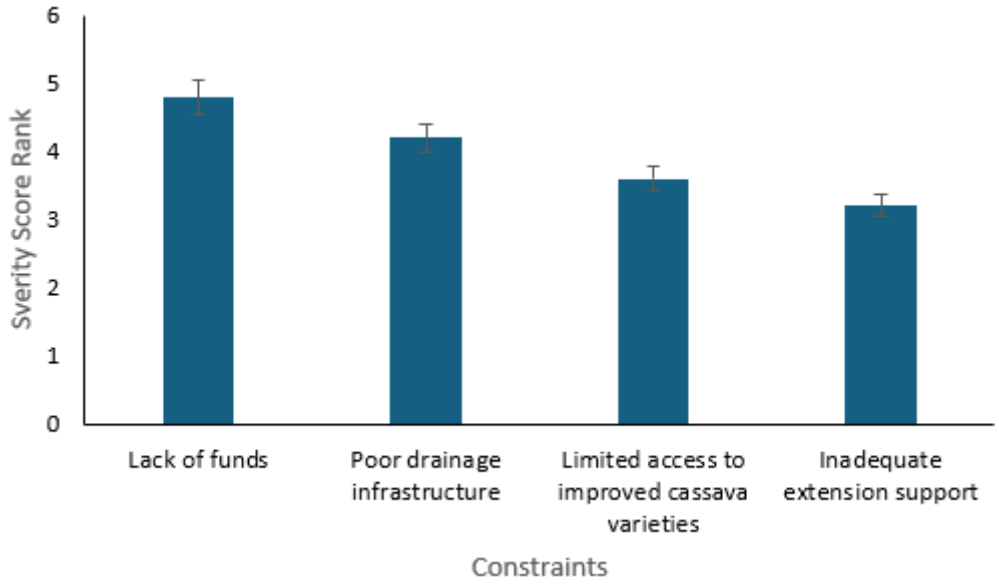

Figure 6. Ranking of major constraints affecting farmers' flood adaptation

4. Conclusion

This study investigated the coping strategies adopted by cassava farmers and the socioeconomic and institutional factors influencing their adoption in flood-prone communities of Omoku in the Niger Delta region of Nigeria. Flooding remains one of the most significant climate-related hazards affecting agricultural productivity in the region, threatening food security and the livelihoods of smallholder farmers.

The findings reveal that farmers employ several agronomic and management strategies to mitigate flood-related risks. The most widely adopted strategies include ridging or mounding, early harvesting, crop diversification, and adjustment of planting dates. These practices represent relatively low-cost adaptation measures that farmers can implement with limited financial resources. Ridging was identified as the most commonly practiced strategy due to its effectiveness in improving soil drainage and reducing waterlogging around cassava roots.

The multinomial logit regression results indicate that education level, farm size, access to extension services, and access to credit significantly influence farmers' decisions to adopt coping strategies. Education enhances farmers' awareness of climate risks and their ability to adopt innovative agricultural practices, while larger farm sizes provide greater flexibility for implementing risk-management strategies. Institutional factors such as extension services and credit access were also found to play a critical role in facilitating adaptation behaviour by providing farmers with technical knowledge and financial resources necessary for implementing improved farming practices.

The marginal effects analysis further demonstrated that access to credit had the strongest influence on adaptation behaviour among all explanatory variables, highlighting the importance of financial inclusion in strengthening agricultural resilience to climate variability. However, despite the adoption of several coping strategies, farmers continue to face multiple constraints that limit their adaptive capacity. The most significant barriers identified include lack of financial resources, poor drainage infrastructure, limited access to improved cassava varieties, and inadequate extension support.

Overall, the study underscores the need for strengthened institutional support systems to enhance farmers' resilience to flood risks in the Niger Delta region. Policy interventions aimed at improving rural financial inclusion, expanding agricultural extension services, promoting the dissemination of flood-tolerant cassava varieties, and investing in rural drainage infrastructure are essential for sustaining cassava production under increasing climate variability.

Enhancing farmers' adaptive capacity will not only reduce vulnerability to flood hazards but will also contribute to improved food security, rural livelihoods, and sustainable agricultural development in flood-prone regions of Nigeria.

Author Contributions

Raymond Alex Ekemube: Conceptualization, Methodology, Software. Jesinta Osere: Data curation, Writing - Original draft preparation. Tina I. Francis-Akilaki: Visualization, Investigation. Egbo D. Macaulay: Supervision. Tamunokuro Oswald Amgbara: Writing - Reviewing and Editing.

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Declaration of Conflicting Interests

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References

Abaje, I. B., Sawa, B. A., & Ati, O. F. (2014). Climate variability and change: Impacts and adaptation strategies in Dutsin-Ma local government area of Katsina State, Nigeria. *Journal of Geography and Geology, 6*(2), 68–72. https://doi.org/10.5539/jgg.v6n2p68

Abam, T. K. S. (2006). Development policy framework for erosion and flood control in the Niger Delta. *Environmental Geology, 51*, 731–738. https://doi.org/10.1007/s00254-006-0356-3

Abolade, A. P., Lawal, I. O., Akanbi, K. L., & Salami, A. O. (2025). Access to finance and sustainable agribusiness performance among smallholder farmers. *Agricultural Finance Review, 85*(2), 221–238. https://doi.org/10.1108/AFR-XX-XXXX

Adelekan, I. O. (2016). Flood risk management and climate adaptation in Nigeria. *Natural Hazards, 82*(3), 1649–1666. https://doi.org/10.1007/s11069-016-2246-4

Ayanlade, A., Radeny, M., & Morton, J. (2023). Climate variability and smallholder agricultural resilience in West Africa. *Climate Risk Management, 40*, 100492. https://doi.org/10.1016/j.crm.2023.100492

Baffour-Ata, F., Boakye, L., Acquah, L. E., Brown, S. B., & Marfo, A. A. (2024). Barriers to adoption of climate-smart agriculture among cassava farmers. *Agriculture and Human Values, 41*(1), 145–160. https://doi.org/10.1007/s10460-023-10458-5

Emmanuel, O. E., Igberi, C. O., & Ehirim, N. C. (2023). Climate change impacts and adaptation strategies among cassava farmers in Nigeria. *Journal of Agricultural Extension, 27*(1), 35–48.

Food and Agriculture Organization. (2023). *FAOSTAT statistical database*. https://www.fao.org/faostat/

Howeler, R., Lutaladio, N., & Thomas, G. (2020). *Save and grow: Cassava—A guide to sustainable production*. Food and Agriculture Organization.

Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press. https://doi.org/10.1017/9781009325844

Jarvis, A., Ramirez-Villegas, J., Herrera-Campo, B., & Navarro-Racines, C. (2022). Climate change and cassava productivity. *Global Food Security, 34*, 100645. https://doi.org/10.1016/j.gfs.2022.100645

Marcus, N. D. (2024). Community-based adaptation strategies among cassava farmers in Nigeria. *Journal of Renewable Agricultural Technology Research, 3*(2), 55–68.

Ndamani, F., & Watanabe, T. (2016). Climate adaptation strategies among smallholder farmers. *Sustainability, 8*(8), 673. https://doi.org/10.3390/su8080673

Nigerian Meteorological Agency. (2023). *Annual climate review bulletin*. NiMet.

Nweke, F., Spencer, D., & Lynam, J. (2020). *The cassava transformation in Africa*. Michigan State University Press.

Ogundeji, A. A. (2022). Adaptation to climate change among smallholder farmers in Africa. *Agriculture, 12*(5), 589. https://doi.org/10.3390/agriculture12050589

Okogbenin, E., Setter, T., Ferguson, M., Mutegi, R., & Ceballos, H. (2013). Breeding cassava for adaptation to climate change. *Field Crops Research, 152*, 1–10. https://doi.org/10.1016/j.fcr.2013.06.004

Olanrewaju, R. M., Ajayi, V. O., & Kareem, A. (2019). Flood impacts on root crop production in southern Nigeria. *African Journal of Agricultural Research, 14*(8), 1045–1055. https://doi.org/10.5897/AJAR2018.13845

Pingali, P., Aiyar, A., Abraham, M., & Rahman, A. (2022). *Transforming food systems for sustainable development*. Oxford University Press.