



Adaptation Strategies to Climate Variability Among Maize Farmers in Oyo State, Nigeria

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Abstract

This study examined the adaptation strategies employed by maize farmers in Oyo State, Nigeria. A multistage sampling procedure was used to select 234 maize farmers, and data were collected through a structured questionnaire. Findings revealed that the most significant constraints were limited access to credit (85.5%), high labour costs (89.3%), and rising input prices (55.1%). Additionally, poor access to climate information was reported by 49.2% of respondents as a challenge. Climate change was found to affect maize production through frequent storms ($\bar{x} = 4.72$), rising crop disease incidence ($\bar{x} = 4.44$), and higher production costs ($\bar{x} = 4.52$). The most commonly adopted adaptation strategies were fertilizer application ($\bar{x} = 3.75$) and the use of improved maize varieties ($\bar{x} = 2.97$), while irrigation ($\bar{x} = 1.69$) and organic manure use ($\bar{x} = 1.30$) were less frequently employed. The study highlighted the importance of access to credit, reliable climate information, and strengthened extension services to enhance resilience. The study recommends strengthening extension services and leveraging agricultural associations such as the Maize Association of Nigeria (MAAN) by all stakeholders to deliver timely and accurate climate information.

Introduction

Agriculture remains the backbone of many developing economies, including Nigeria, where a large portion of the population depends on farming for their livelihood (Nwagwugwu et al., 2023). Maize (*Zea mays*) is one of Nigeria's most important staple crops, serving as a key food source and contributing significantly to food security, rural employment, animal feed, and industrial raw materials (Wossen et al., 2023). In Oyo State, maize cultivation plays a vital role in the agricultural sector, supporting both livelihoods and agro-allied industries.

However, maize production in Nigeria, particularly in Oyo State, is increasingly vulnerable to climate variability and change. Climate change poses a serious threat to global agriculture, particularly affecting rain-fed farming, which is the backbone of many developing economies like Nigeria (Agboola et al., 2024). Many smallholder farmers rely on rainfed agriculture due to the small scale of their operations and the high cost of irrigation, making them highly susceptible to shifts in rainfall patterns, rising temperatures, and extreme weather events (Intergovernmental Panel on Climate Change [IPCC], 2021). Climate change has led to erratic rainfall, prolonged droughts, increased pest and disease incidence, and overall lower yields. These environmental stresses are further compounded by socio-economic barriers such as limited access to credit, high input costs, and inadequate extension services (Gidi et al., 2024). Climate projections also indicate significant shifts in Africa's climatic conditions, including increasingly warm and dry weather in the subtropics and higher rainfall in the tropics (Gidi et al., 2024).

In response, farmers have adopted various adaptation strategies, including the use of improved maize varieties, fertilizer application, and adjustments to planting schedules. However, the adoption and effectiveness of these strategies remain uneven and underexplored. Understanding the specific adaptation methods employed by maize farmers, along with the challenges they face, is essential for designing targeted interventions and policies that promote climate resilience.

Although several studies have examined farmers' adaptive responses, there remains a gap in assessing effective adaptation in maize production in Oyo State. These barriers include a lack of timely climate information, limited financial resources, high labour costs, and inadequate infrastructure, particularly for irrigation.

This study, examined the constraints to maize production, the perception of maize farmers to climate variability and the adaptation strategies employed by maize farmers in Oyo State and to identify the socio-economic and environmental constraints that hinder effective responses to climate variability.

Methodology

The study was conducted in Oyo State, Nigeria, with small-scale maize farmers as the target population. Oyo State covers an area of 28,453 square kilometres and lies at latitude 8°00' North and longitude 4°00' East.

A two-stage sampling procedure was adopted to select respondents. In the first stage, three (3) local government areas (LGAs) were randomly selected from across the state. In the second stage, five (5) communities were purposively chosen from each of the selected LGAs, based on the relative concentration of maize farmers, as identified by the Agricultural Development Program (ADP). This resulted in a total of fifteen (15) communities.

To determine the sample size, the total number of registered maize farmers was obtained from the Maize Association of Nigeria (MAAN). Proportionate sampling and Yamane formula was employed to get the sample size.

Thus, a total of 265 small-scale maize farmers were selected for the study. Farmers were proportionally allocated to each community based on the dominance of maize farming. However, due to incomplete responses from some participants, only 234 questionnaires were deemed valid for analysis.

Primary data were collected through a structured questionnaire administered to maize farmers. Information was gathered on farmers' socio-economic characteristics, input prices, maize varieties used, perceptions of climate change, and adaptation strategies. The data collection focused on small-scale maize farmers who cultivated maize during the 2022 main cropping season.

Percentages, and means were used to analyse the adaptation strategies of the respondents

Results and Discussion

Constraints to Maize Production in Oyo State

The results in Table 1 highlight significant challenges hindering maize production in Oyo State. Among the most critical issues are inadequate access to credit and the high cost of labour, with a relative importance index (RII) of 0.96. The limited availability of affordable credit restricts farmers' ability to invest in essential inputs, technologies, and skilled labor, thereby constraining productivity and growth. Likewise, the high cost of labour imposes substantial financial burdens, reducing profitability and discouraging efforts to scale up operations.

The high cost of inputs, (RII = 0.90), further compounds these financial challenges. Maize farmers face steep expenses for necessities such as seeds, fertilizers, and agrochemicals, limiting their ability to adopt improved practices or expand production. Poor access to climate information (RII = 0.88), further hinders decision-making. Without timely and accurate weather forecasts, farmers struggle to plan effectively for adverse conditions, often resulting in reduced yields.

Shortage of arable land and price instability, coupled with poor marketing systems, both scored RII values of 0.86. Limited land access restricts the expansion of maize cultivation, while inefficient markets and fluctuating prices create income instability and planning challenges. Additionally, inadequate irrigation infrastructure (RII = 0.81) and exposure to environmental hazards such as floods, droughts, and soil degradation (RII = 0.81) leave farmers heavily reliant on rainfall and vulnerable to climate-related shocks.

Institutional constraints also persist. Limited access to extension services (RII = 0.80) reduces farmers' exposure to modern techniques, innovations, and agronomic advice. Pest and disease infestations (RII = 0.79) present ongoing threats to yield and income. Meanwhile, poor road infrastructure (RII = 0.78) impedes transportation of both inputs and outputs, adding cost and reducing market access. Theft (RII = 0.78) and the non-availability of agrochemicals (RII = 0.75) remain notable challenges, undermining productivity and discouraging investment.

Overall, these findings reveal the multifaceted nature of constraints faced by maize farmers in Oyo State, spanning economic, environmental, structural, and institutional factors. These challenges are consistent with findings by Omoniyi et al. (2024), that inadequate credit, high input costs, pest pressure, and limited access to climate information and government support. This cross-crop alignment underscores the systemic nature of agricultural constraints in the region, particularly for smallholder farmers.

Table 1: Constraints to maize production in Oyo State

Constraints	RII	SD
Inadequate credit accessibility	0.96	0.489
High cost of labour	0.96	0.643
High cost of input	0.90	0.630
Poor climate information	0.88	0.661
Shortage of land	0.86	0.618
Price instability and poor marketing	0.86	0.870
Poor Irrigation potential	0.81	0.852
Environmental Hazard	0.81	0.843
Inaccessibility to extension service	0.80	0.976
Infestation of disease	0.79	0.972
Poor road network	0.78	0.670
Theft	0.78	0.850
Non-availability of Agrochemical	0.75	1.077

Source: Field survey, 2023

KEY: RII=Relative Importance Index

Perception of Climate Variability

The findings in Table 2 indicate a strong consensus among maize farmers in Oyo State regarding the occurrence and impacts of climate variability. With all indicators surpassing the 2.5 agreement threshold, the results reflect a heightened awareness of climate change and its multifaceted effects on agriculture.

Maize farmers ranked heavy rainfall storms as the most prominent climate change event, ($\bar{x} = 4.72$), indicating strong agreement that this phenomenon had a significant impact in the previous year. This was followed by the adverse effects of climate variability on production output ($\bar{x} = 4.61$), suggesting that changes in climatic conditions are perceived to have directly reduced maize yields. This finding supports previous studies linking climatic shifts to declining agricultural productivity (Farauta, et al., 2014; Malhi, et al., 2021). Farmers' strong agreement on these phenomena, heavy rainfall, reduced production output, and disrupted farm operations, demonstrates a substantial degree of experiential knowledge regarding climate variability. This aligns with research that emphasizes the importance of integrating local and indigenous knowledge into climate resilience strategies (Yeleti, et al, 2023).

Farmers also strongly agreed that climate change has disrupted farm operations ($\bar{x} = 4.58$). This suggests that weather variations, such as erratic rainfall and temperature fluctuations, have interfered with farming activities. The increasing costs of maize production were ranked fourth ($\bar{x} = 4.52$), highlighting how climate-induced challenges have escalated the financial burden on farmers. Similarly, the rise in heat waves, heat stress, and related disorders ($\bar{x} = 4.49$) was a significant concern. This indicates that rising temperatures poses not only agronomic challenges but also labour and public health risks.

The perception of increased crop infestation and disease due to climate variability ranked sixth ($\bar{x} = 4.44$), emphasizing the growing vulnerability of maize crops to pests and diseases. This also highlights the broader ecological impacts of climate change, as warmer and more erratic conditions are known to intensify pest and disease outbreaks (Adunola, et al, 2020). Flooding during the rainy season is also

linked to the changing climate patterns ($\bar{x}$ = 3.98); although it is less prominent than other concerns, it still reflects an awareness of shifting rainfall patterns and their potential effects on agricultural productivity. Finally, the destruction of maize fields by wind was ranked eighth ($\bar{x}$ = 3.82), showing that farmers also recognize the damaging effects of strong winds associated with climate variability.

In summary, the findings reveal a strong consensus among maize farmers in Oyo State about the significant impacts of climate change on their farming activities, production output, and costs. Farmers widely perceive climate change as a critical challenge that necessitates adaptive strategies to mitigate its adverse effects on maize production. These results also demonstrate a broad and nuanced understanding of climate variability among the farming population.

Table 2: Climate change occurrence

Variables	Mean	SD
There was a heavy rainfall storm last year	4.72	0.732
Climate change affected production output	4.61	0.960
Variation in climate has caused an increase in the incidence of floods during the rainy season	3.98	0.964
Increase crop infestation and diseases	4.44	0.977
Increase in maize production cost	4.52	1.010
There was increase in heat-wave, heat-stress, and heat related disorders than before	4.49	0.873
Climate change affected farm operations	4.58	1.053
Destruction of maize field by wind	3.82	1.083

Source: Field survey, 2023

Adaptation Strategies to Climate Variability

Table 3 presents the climate variability adaptation strategies adopted by maize farmers. Fertilizer application ($\bar{x}$ = 3.75) is the most prominent strategy. This highlights its perceived effectiveness in mitigating the adverse effects of climate change on soil fertility and crop productivity. Farmers widely rely on fertilizers to sustain yields despite changing climatic conditions.

Improved crop varieties ($\bar{x}$ = 2.97) indicate a relatively high level of adoption among farmers. This suggests that such varieties are valued for their resilience to climate-related stressors, including drought, pests, and diseases. Fallowing ($\bar{x}$ = 2.81) also received considerable support, underscoring its continued importance as a traditional practice for restoring soil fertility and mitigating land degradation associated with climate variability.

Crop rotation ($\bar{x}$ = 2.16) received moderate agreement, reflecting its recognized role in disrupting pest and disease cycles and improving soil health. Diversification strategies, such as adopting alternative income sources or farming practices, received a mean score of 2.11, indicating limited yet noteworthy uptake. This implies that some farmers are beginning to explore diversification as a means of spreading risk and enhancing resilience to climate-related shocks.

Conversely, several adaptation strategies were met with lower levels of agreement, reflecting limited adoption or perceived ineffectiveness. Irrigation ($\bar{x}$ = 1.69) scored low, likely due to constraints related to water availability or infrastructure. Similarly, the use of organic manure ($\bar{x}$ = 1.30), mulching ($\bar{x}$ = 1.41), and cover cropping ($\bar{x}$ = 1.09) were among the least adopted practices. These low scores may be attributed

to barriers such as inadequate knowledge, limited access to resources, or the lack of immediate and observable benefits.

These results imply that maize farmers in Oyo State prioritize adaptation strategies that offer immediate and tangible returns, such as fertilizer application and improved crop varieties. While traditional practices like fallowing and crop rotation remain relevant, their use may be constrained by land availability or labour demands. The low adoption of ecologically sustainable practices such as organic manure, mulching, and cover cropping points to gaps in farmer training, resource access, or extension services. This reliance on a narrow range of adaptation strategies may pose long-term risks, limiting the resilience of maize farming systems to future climate variability.

Table 3: Strategies for adaptation to climate variabilities

Variables	Mean	Standard Deviation
Fertilizer application	3.75	0.784
Crop rotation	2.16	0.666
Fallowing	2.81	0.760
Use of improved variety	2.97	0.744
Irrigation	1.69	0.925
Organic manure usage	1.30	1.047
Diversification	2.11	0.872
Mulching	1.41	0.771
Cover cropping	1.09	0.817

Source: Field survey, 2023

Conclusion and Recommendations

Access to essential resources such as credit facilities, extension services, and climate information remains a challenge for many farmers. Climate variability is recognized as a significant factor affecting maize production, manifesting in heavy rainfall, increased heat waves, and disruptions to farm operations. Despite this, adaptation strategies namely fertilizer application and improved crop varieties, are widely adopted, while other methods namely, irrigation, organic manure, and mulching, remain underutilized due to infrastructural, economic, or knowledge-related barriers.

Farmers adopt irrigation systems to reduce their reliance on rainfed agriculture, enabling them to better cope with irregular rainfall patterns and prolonged dry spells. Furthermore, strengthening extension services and leveraging agricultural associations such as the Maize Association of Nigeria (MAAN) to deliver timely and accurate climate information can significantly enhance farmers' decision-making and adaptive capacity. Finally, government agencies, agricultural extension services, and NGOs should prioritize awareness campaigns and training that promote sustainable practices, including mulching, the use of organic manure, and cover cropping, which are currently underutilized but offer significant long-term benefits for soil health and climate resilience.

References

- Adunola, M. P., Fayeun, L. S., & Fadara, A. B. (2020). Impact of climate change on armyworm infestation on maize in Nigeria: A review. *Journal of Plant Breeding and Crop Science*, 13(3), 158 -167.
- Agboola, A. F., Famakinwa, M., Williams, S. O., and Akerele, O. A. (2024). Indigenous climate change adaptation strategies among crop farmers in Osun State, Nigeria. *Journal of Agricultural Extension*, 28(3), 134-143.
- Farauta, B. K., Egbule, C. L., Agwu, A. E., Idrisa, Y. L., & Onyekuru, N. A. (2014). Farmers' Adaptation Initiatives to the Impact of Climate Change on Agriculture in Northern Nigeria. *Journal of Agricultural Extension*, 16(1). Retrieved from <https://www.aesonnigeria.org/ajm/index.php/jae/article/view/160>
- Gidi, L. S., Mdoda, L., Ncoyini-Manciya, Z., & Mdiya, L. (2024). Climate change and small-scale agriculture in the Eastern Cape Province: Investigating the nexus of awareness, adaptation, and food security. *Sustainability*, 16(22), 9986. <https://doi.org/10.3390/su16229986>
- Intergovernmental Panel on Climate Change. (2021). *Sixth assessment report: Impacts, adaptation, and vulnerability*. <https://www.ipcc.ch/report/ar6/wg2/>
- Malhi, G. S., Kaur, M., & Kaushik, P. (2021). Impact of climate change on agriculture and its mitigation strategies: A review. *Sustainability*, 13(3), 1318. <https://doi.org/10.3390/su13031318>
- Nhung, P. T. C., & Wang, Z. (2022). Vietnam rice competitiveness in the industrial trade market in recent years: Opportunities and new challenges for Vietnam rice export. *Journal of Industrial and Business Management*, 12(12), 28–45.
- Nwagwugwu, U. C. C., Nwokoye, E., & Osai, V. A. (2023). The role of agriculture in economic development in Nigeria. *Journal of International Economic Relations and Development Economics*, 3(1), 103–111.
- Omoniyi, L. O., Olorunshola, E. O., & Ogunyinka, A. I. (2024, May). Assessment of rice farmers' vulnerability to climate change in Ekiti State, Nigeria. Paper presented at the 17th Annual Conference of the International Research and Development Network of Children and Youth in Agriculture Programme (CYIAP), Obafemi Awolowo University, Ile-Ife, Nigeria.
- Oyewole, A. L., & Oyewole, S. O. (2023). Analysis of sustainable agricultural practices and profit efficiency of maize farmers in Oyo and Ogun States, Nigeria. *Journal of Applied Sciences and Environmental Management*, 27(4), 841–848.
- Wossen, T., Menkir, A., Alene, A., Abdoulaye, T., Ajala, S., Badu-Apraku, B., Gedil, M., Mengesha, W., & Meseka, S. (2023). Drivers of transformation of the maize sector in Nigeria. *Global Food Security*, 38, 100713. <https://doi.org/10.1016/j.gfs.2023.100713>