Educational Advancement and Development Journal (EADJ)
Volume 1 Number 2 December 2025, pp 49-58
E-ISSN: 3104-8390
https://neadafrica.com/journals/neadj

Investigating the Role of Climate-Smart Agricultural Practices in Lagos State, Nigeria

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Abstract

This study explored the role of climate-smart agricultural practices in enhancing food security in Lagos State, Nigeria. Two research objectives and questions guided the study. The study employed a descriptive survey research design and a multi-stage sampling technique to choose respondents from farm families in five villages: Igboye, Araga (Epe LGA), Ajara, Ibereko (Badagry LGA), and Tafi (Ojo LGA). These communities were purposefully picked in the first step, and 100 farmers (20 per village) were chosen at random in the second stage according to the size of the farm family. To assess Climate Smart Agriculture implementation (such as conservation tillage and drought-resistant crops) and its perceived impacts on resilience and food security, a 20-item survey using a 4-point scale was used. Three experts from Tai Solarin University of Education's College of Vocational and Technology Education provided face validations for the instrument. The descriptive statistics of weighted mean and standard deviation were used to analyze the data using SPSS. Findings showed that, due to resource and financial limitations, farmers disagreed about how much CSA methods contribute to food security, as seen by the low adoption rate. In contrast, findings indicated that farmers strongly agreed that CSA had a beneficial impact on the resilience of farming systems to climate change. For sustainable agriculture in Lagos State, the study suggests improved extension services, financial incentives, and legislative frameworks to encourage the implementation of CSA and capitalize on its resilience advantages.

Keywords: Climate-smart agriculture, food security, adoption, impact, Lagos State

History:
Received : October 6, 2025
Revised : October 27, 2025
Accepted : November 30, 2025
Published : December 31, 2025
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Publisher: Network for Educational Advancement and Deve lopment

INTRODUCTION

Agricultural productivity is greatly impacted by climate change globally, especially in vulnerable areas such as Nigeria, where agriculture is primarily rain-fed and subject to climatic fluctuations. In a time when the consequences of climate change are becoming more obvious, it is essential to comprehend and reduce climate risks, especially for areas that are extremely susceptible to environmental changes. According to Onyeneke (2019), climate change offers a substantial danger to agricultural productivity in Nigeria, with indications of altering rainfall patterns, severe weather events and rising temperatures. These detrimental effects of climate change on global crop production has been well documented (Miller *et al*. 2021; Schmitt *et al.* 2022). Lagos State, with its coastal climate and varied ecosystems, is at the vanguard and faces particular difficulties brought on it by climatic unpredictability and change. (Ndimele, *et al*, 2024). Climate change poses significant challenges to food security in Lagos State, with rising temperatures and erratic rainfall affecting crop yields.

The profound impacts of climate change on agricultural productivity, where rain-fed agriculture is highly vulnerable to climatic fluctuations, underscore the urgent need to address environmental risks in this coastal region with its diverse ecosystems (Ndimele *et al*., 2024). The combined problems of droughts and floods—both of which have increased in frequency and severity as a result of climate change—are posing an increasing danger to this important sector (Akinsanola & Ogunjobi, 2014; Bello *et al*., 2017). Akinbami and Ibikunle (2019) draw attention to the complex interrelationship between Nigerian food security and climate change, which is impacted by a number of social, economic, and environmental factors. Food security, according to the Food and Agriculture Organization (FAO, 2024) exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

A key tactic to improve resilience and sustainability is the implementation of Climate-Smart Agriculture (CSA), as rising temperatures, unpredictable rainfall, and flooding pose a danger to agricultural yields and food security, CSA incorporates techniques which includes minimal soil disturbance, maintaining soil cover, and crop rotation (which enhance soil health and reduce erosion) (Bhanuwanti *et al.,* 2024). The use of climate-resilient crops, such as drought-tolerant and disease-resistant varieties, is crucial for maintaining productivity under changing climatic conditions (Safdar *et al*., 2024).

In recent years, development organizations such as the FAO (2010) have advocated the idea of "Climate Smart Agriculture" (CSA). In 2010, the FAO coined the acronym "CSA" to address the difficulties of providing food security for a rising population while cutting greenhouse gas emissions from the forestry and agriculture subsectors (Food and Agriculture Organization of the United Nations (FAO), 2013). A group of techniques and resources known as Climate Smart Agricultural Technologies (CSATs) are intended to assist farmers in raising agricultural output in a sustainable way, particularly in rural regions where farming serves as the primary source of income (Terdoo, 2020).

Modern Climate-Smart Agriculture Technologies (CSAT) including precision farming, vertical farming, and agricultural drones are revolutionizing farming methods around the world. Farmers can make well-informed decisions about the best times to plant, fertilize, irrigate, or apply pesticides by using precision agriculture, which uses sophisticated sensors and data analytics to provide real-time, comprehensive insights into soil health, nutrient profiles, moisture levels, and pest pressures (Cisternas, *et al.,* 2020). By using controlled-environment agriculture (CEA) techniques such as hydroponics, aeroponics, and Light-emitting diode LED lighting to grow crops in vertically stacked systems. , Vertical farming is a novel method that reduces the need for chemical pesticides, conserves water, and allows for continuous, year-round production (Özgüven *et al.,* 2022). With high-resolution cameras, sensors, and GPS technology, agricultural drones, also known as Unmanned Aerial Vehicles (UAVs), improve precision agriculture by creating comprehensive farmland maps, tracking plant growth patterns, evaluating soil moisture, monitoring crop stress, and optimizing resource use (Özgüven *et al.,* 2022).

These technologies are in perfect harmony with the tenets of Climate-Smart Agriculture (CSA), which incorporates methods to increase food security, lower greenhouse gas emissions, and strengthen climate change resilience. Farmers in Lagos State, Nigeria, where climate unpredictability, such as unpredictable rainfall and flooding, threatens agricultural productivity, must embrace CSA practices (Ndimele *et al*., 2024). Despite the promotion of CSA initiatives, such as water conservation methods and drought-resistant crops, rural farmers' adoption of these approaches is uneven and frequently constrained by a lack of resources and insufficient extension services (Akinkuolie *et al*., 2025). Additionally, it is yet unknown how these actions are perceived to affect resilience and food security, which highlights a crucial study gap.

Climate-Smart Agriculture (CSA) practices, such as the use of improved crop varieties and effective nutrient management, have been demonstrated to significantly enhance agricultural productivity in Nigeria (Balogun *et al.,* 2024). Additionally, precision agriculture techniques, including the use of drones for targeted interventions like precision spraying and crop health monitoring, optimize resource use and further improve yields (Rishikesavan *et a*l., 2024). In south western Nigeria, CSA methods used drought-resistant cultivars to boost maize yields by 20% (Ogunyiola *et al.,* 2022).). FAO's global study from 2023 emphasized that CSA improves soil health and water management, which in turn increases resilience. Integrating advanced Climate-Smart Agriculture Technologies (CSAT), such as drones and precision agriculture, with traditional CSA methods could potentially enhance food security, increase adoption rates, and strengthen climate resilience in Lagos State. This approach may also promote sustainable agricultural development while addressing challenges posed by climatic variability. However, adoption rates in Nigeria are low because of lack of resources and knowledge, according to Okoro and Eze (2024).

Despite the promotion of CSA practices including water conservation methods and drought-resistant crops, rural farmers continue to implement them unevenly. The disparity in the adoption of Climate-Smart Agriculture (CSA) practices by farmers in rural Lagos State, Nigeria, presents significant challenges to enhanced resilience and food security. This study intends to bridge the gap in knowledge towards understanding the adoption and impact of CSA practices in the nation by establishing the key factors influencing their adoption. Socioeconomic constraints, such as inaccessibility to information, poor resources, and socio-cultural boundaries, significantly hinder farmers from adopting CSA approaches (Fawole & Aderinoye-Abdulwahab, 2021). Environmental variability may also have the ability to create trade-offs because CSA approaches towards long-term sustainability may sometimes conflict with immediate food production needs (Eze & Abe, 2024).

Besides, education and awareness will be necessary to boost levels of adoption because greater awareness of the benefits of CSA encourages adoption among farmers (Investigating the Adaptive Practices, 2023). Concerning the effect, CSA techniques such as soil conservation and water conservation have been proved to increase the value of crop production by 17-24%, hence boosting food security (Olarinde et al., 2011). These practices also lead to enhanced dietary diversity and food intake scores for rural households, which minimize food insecurity (Omotoso & Omotayo, 2024). In spite of these potential advantages, there are challenges to effective adoption, which warrant efforts aimed at improved understanding and uptake. Overcoming these challenges is key to scaling up sustainable agricultural growth and maintaining food security in Lagos State.

Furthermore, it's unclear how these practices are considered to affect resilience and food security. The adoption and effects of CSA practices in Lagos State are not well understood, which is why this study was conducted. Hence, this study tends to bridge the gap in the adoption and impact of CSA practices in Lagos State, Nigeria.

Objectives of the Study

The study aims to achieve the following objectives to:

1. examine the perceived impact of climate-smart agricultural practices on the resilience of farming systems against climate change.
2. assess the extent to which farmers in Lagos State have adopted climate-smart agricultural practices to improve food security.

Research Questions

The following research questions were used to guide the study:

1. What is the perceived impact of climate-smart agricultural practices on the resilience of farming systems against climate change?
2. To what extent have farmers in Lagos State adopted climate-smart agricultural practices to enhance food security?

METHODOLOGY

The research was conducted in Lagos, Nigeria. Lagos State is the smallest state in Nigeria in terms of land size, covering 356,861 hectares, of which 169,613 hectares are set aside for agricultural and 75,755 hectares are wetland. Only 30% of the area that was initially designated for agriculture is now under cultivation (National Bureau of Statistics, 2010). Ogun State borders Lagos State in the north and east. It shares borders with the Republic of Benin in the West. The Atlantic Ocean is located behind its southern limits. Approximately 22% of its 3,577 km2 area is made up of creeks and lagoons. The port of Lagos was founded on islands that were divided by creeks (Lagos State Government, 2017). This study adopted the descriptive survey research. The study's respondents were chosen using Multi-stage sampling approach. The farming families from five different villages distributed over Lagos State made up the sampling frame. The Lagos State Agricultural Development Authority (LASADA) provided this information. Igboye and Araga, all in Epe Local Government Area (LGA), Ajara and Ibereko in Badagry LGA, and Tafi in Ojo LGA were the five localities with the farm settlement that were purposefully employed in the first stage. In the second phase, farmers were chosen at random based on the size of the farm family in each community that was chosen. A total of 100 farmers were chosen and employed for the study: 20 from Igboye (20), Araga (20), Ajara (20), Ibereko (20), and 20 from Tafi (Ojo LGA). A 20-item questionnaire with a 4-point scale (Strongly Agree = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1) was used in the questionnaire to evaluate the adoption of Climate-Smart Agriculture (CSA) practices, such as conservation tillage, drought-resistant crop use, agroforestry, integrated pest management, and crop rotation,as well as their perceived effects on resilience and food security. To assess the degree of CSA implementation and its impact on study agricultural results, weighted mean and standard deviation were used with a cut-off point of 2.50. Hence, 1.00- 2.49 was adjudged to be disagreement while 2.50 – 4.00 was agreement. Statistical Package for the Social Sciences (SPSS) was used as analytical software. The instrument was validated by three experts from the College of Vocational and Technology Education, Tai Solarin University of Education using face validity.

RESULTS

The Tables below presented the mean and standard deviation for each statement, reflecting the level of agreement among farmers and extension officers.

Research Question1: What is the perceived impact of climate-smart agricultural practices on the resilience of farming systems against climate change?

Table 1: Mean response of respondents on the perceived impact of climate-smart agricultural practices on the resilience of farming systems against climate change

S/n	Item Statements	X	SD	Decision
1.	I believe that using drought-resistant crop varieties can greatly reduce crop losses during dry spells, thereby improving my farm's resilience to climate change.	3.20	0.7	Agreed
2.	In my view, conservation tillage practices, such as minimal tillage, can enhanced soil health, helping my farm withstand climate-related challenges like flooding.	3.10	0.6	Agreed
3.	I perceive that improved water management techniques, such as rainwater harvesting, have ensured stable crop yields despite unpredictable rainfall caused by climate change.	3.25	0.5	Agreed
4.	I feel that diversifying crops can made my farm more resilient to climate shocks by providing alternative income sources during adverse weather conditions.	3.15	0.7	Agreed
5.	I think that adopting agroforestry practices can strengthen my farm's resilience by improving soil fertility and mitigating the effects of rising temperatures.	3.05	0.8	Agreed
6.	CSA practices like organic fertilizers can reduce my farm's susceptibility to climate-induced soil degradation.	3.00	0.6	Agreed
7.	I perceive that climate-smart pest management strategies can effectively minimize crop damage from pests worsened by changing climate conditions.	3.10	0.7	Agreed
8.	I believe that CSA training can enhance my confidence in adapting farming practices to cope with climate variability and extreme weather.	3.30	0.5	Agreed
9.	In my opinion, integrating CSA practices will increase my farm's productivity, making it better equipped to handle the impacts of climate change.	3.20	0.6	Agreed
10.	I feel that CSA practices can enable my farming system to recover more effectively from climate-related disruptions, such as droughts or floods, ensuring its sustainability.	3.15	0.7	Agreed
	Grand Mean	**3.15**		**Agreed**

Table 1 show that the mean scores for all 10 items range from 3.00 to 3.30, all above the cut-off point of 2.50, indicating that respondents agreed with the item statements on the perceived impact of CSA practices on farming system resilience. The grand mean of 3.15 reinforces a positive perception, suggesting that the farmers agreed in the 10 item statements as perceived impact of climate-smart agricultural practices on the resilience of farming systems against climate change.

Research Question: Extent to which farmers in Lagos State have adopted climate-smart agricultural practices to enhance food security?

Table 2: Mean response of respondents on the extent farmers in Lagos State adopted climate-smart agricultural practices to enhance food security

S/n	Item Statements	$\bar{X}$	SD	Decision
1.	I am aware of climate-smart agricultural practices.	2.40	0.8	Disagreed
2.	I have adopted drought-resistant crops as part of my farming practices.	2.10	0.7	Disagreed
3.	I use water conservation techniques to manage climate challenges.	2.05	0.6	Disagreed
4.	Climate-smart agricultural practices have increased my crop yields.	1.95	0.7	Disagreed
5.	Climate-smart practices have improved my ability to withstand climate shocks.	2.00	0.8	Disagreed
6.	I receive adequate support from extension officers for climate-smart practices.	1.85	0.9	Disagreed
7.	Climate-smart agriculture has enhanced food security for my household.	1.90	0.7	Disagreed
8.	I face financial constraints in adopting climate-smart practices.	2.30	0.8	Disagreed
9.	I believe climate-smart agriculture is essential for sustainable farming.	2.45	0.6	Disagreed
10.	I have access to resources needed for climate-smart agriculture.	1.80	0.9	Disagreed
	Grand Mean	**2.08**		**Disagreed**

Table 2 shows that the mean scores for all 10 items range from 1.80 to 2.45, all below the cut-off point of 2.50, indicating that respondents disagreed with the statements on the extent of CSA adoption for enhancing food security. The grand mean of 2.08 further confirms low adoption levels, reflecting that the farmers disagreed on the 10 item statements on extent farmers in Lagos State adopted climate-smart agricultural practices to enhance food security.

Discussion of Findings

Result in Table 2 shows that respondents consistently agreed with all item statements, suggesting that Climate-Smart Agriculture (CSA) techniques had a good perceived impact on the resilience of farming systems in Lagos State, Nigeria, against the difficulties posed by climate change. This finding aligns with Khan *et al.,* (2024) whose study stated that CSA practices are crucial for adapting to climate change, as they enhance agricultural productivity and resilience while reducing greenhouse gas emissions. The findings is also in concordance with the study of Ben-Chendo, *et al* (2022), Onyeneke *et al*, (2021) and Shittu *et al.*, (2021) that all posited that while Climate Smart Agriculture offers a promising approach, current practices in Nigeria remain unorganized and lack policy frameworks for effective implementation. The study is also consistent with the work of FAO (2013) where it was stated that CSA practices like drought-resistant crops, conservation tillage, and water management are seen as effective in enhancing resilience against climate change challenges and that of Bhatnagar *et al.,(*2024) whose study revealed that CSA practices contribute to boosting crop yields, enhancing income for farmers, increasing resource utilization efficiency, increasing resilience to climate change, and decreasing GHG emissions, which is reflected in our findings.

The result of the study in table 2 indicated that the respondents disagreed with all the items statements and this shows that the extent to which farmers in Lagos State adopted climate-smart agricultural practices to enhance food security is still very low. This finding is in agreement with the study of Mbanasor *et a.l*, (2024) who found out that Climate Smart Agriculture practices were relatively poor in conservation agriculture. The findings is also in concordance with the study of Ben-Chendo, *et al* (2022), Onyeneke *et al*, (2021) and Shittu *et al*, (2021) that all posited that while Climate Smart Agriculture offers a promising approach, current practices in Nigeria remain unorganized and lack policy frameworks for effective implementation. The study is also consistent with the work of MacManus *et al* (2023) who stated that many farmers adhere to traditional agricultural methods and lack the financial resources to adopt CSA practices and that of Okoro & Eze (2024) who noted that financial constraints and limited resource access are major barriers to CSA adoption in Nigeria, which is reflected in our findings. The findings is also in line with the study of Mbanasor *et al.,* (2024) which identified barriers such as financial constraints, limited extension support, and lack of resources to adoption of CSA and hence consistent with the study's narrative and prior studies.

CONCLUSION

The study reveals a multifaceted interplay in the adoption and perceived impacts of Climate-Smart Agriculture (CSA) practices among farmers in Lagos State, Nigeria, driven by limited awareness, financial constraints, and uneven access to technology and extension services. The low use of CSA techniques to improve food security is a reflection of major obstacles that prevent widespread adoption, such as lack of funding, dependence on conventional farming methods, and insufficient policy backing. These difficulties are consistent with earlier studies that highlighted conservation agriculture's shortcomings and Nigeria's dearth of formal CSA frameworks.

On the other hand, there is a firm conviction that CSA practices, backed by the acknowledged role of extension services, successfully increase the resilience of farming systems against the difficulties posed by climate change, even though farmers now receive little support. Lagos State needs focused tactics, like improved extension services, financial incentives, and strong policy frameworks to support cutting-edge CSA technology, to address these problems and build on the favorable opinions of CSA's potential. Lagos State can ensure sustainable farming systems for the future by removing these obstacles and enhancing food security, agricultural resilience, and the negative effects of climatic variability.

RECOMMENDATIONS

The following recommendations are put forth in light of the study's findings:

1. Extension officers should intensify awareness campaigns on CSA practices through workshops and demonstrations to increase adoption rates.
2. The government should provide subsidies for CSA inputs, such as drought-resistant seeds, to make them more accessible to farmers.
3. Farmer cooperatives should be encouraged to share knowledge and resources for implementing CSA practices effectively.

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