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Effects of Climate-smart Agricultural Practices on Cassava Farmers' Output in Ebonyi State, Nigeria

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Abstract

The study assessed the effects of climate-smart agricultural practices on cassava farmers' output in Ebonyi State, Nigeria. A multi-stage sampling procedure was employed to select 120 respondents. Data were analysed using percentages, mean statistics and correlation analysis. The results show that early planting was adopted by 100% of farmers. However, a lack of credit (78.33%) was ranked as the highest constraint. A statistically significant positive correlation (0.3131) was found between climate-smart agricultural practices and output. The study concludes that early planting practices are widely adopted, while lack of credit presents a significant challenge to adopting Climate-Smart Agriculture (CSA) practices. Despite these challenges, CSA practices were found to have the ability to enhance cassava farmers' output. To overcome these challenges, the study recommends implementing robust extension services, providing financial support, and offering education programmes to promote CSA adoption among farmers.

Keywords: Climate-smart practices, agricultural production, cassava output

Introduction

Climate change poses a significant threat to global food security, especially in rural areas where farming is the primary means of survival. This is particularly evident in developing countries such as Nigeria, where cassava is a staple crop. In Ebonyi State, cassava output is vital for both food security and the livelihoods of smallholder farmers. However, cassava is susceptible to the adverse effects of climate change, including rising temperatures and changing precipitation patterns, which result in decreased yields and productivity (Wu et al., 2019).

To address these challenges, Climate-Smart Agriculture (CSA) techniques emerged as a promising solution. CSA encompasses a variety of practices aimed at enhancing agricultural output while simultaneously mitigating the effects of climate change and reducing greenhouse gas emissions. Research has shown that CSA practices such as agroforestry, crop rotation, improved seed varieties, conservation agriculture, and water harvesting are climate-smart because they simultaneously address productivity, adaptation, and mitigation (Omotoso and Omotayo, 2024). Also, studies highlighted the benefits of CSA in different contexts, demonstrating its potential to transform agricultural practices and outcomes (Omotoso and Omotayo, 2024; Santalucia, 2023; Tabe-Ojong et al., 2023; Vatsa et al., 2023; Aidoo et al., 2022; Akter et al., 2022; Jamil et al., 2021; McNunn et al., 2020; Makate et al., 2019).

In Ebonyi State, the implementation of CSA practices was crucial for strengthening the resilience and adaptability of cassava farming to climate change. Several factors influenced the practice of CSA techniques. These include farmers characteristics such as age, education, and farming experience; farm-level characteristics like farm size, soil quality, access to water; and institutional factors including access to extension services, credit, and markets; and broader climatic conditions. Understanding these factors was critical for designing effective policies and interventions to promote CSA practice (Belay et al., 2023; Zhou et al., 2023; Diro et al., 2022; Kifle et al., 2022; Kangogo et al., 2021; Tran et al., 2020; Zakaria et al., 2020).

In addition to examining these factors, the study reviewed existing research and initiatives that promoted CSA practices in Ebonyi State. Various organisations and institutions had been involved in promoting CSA in the region. The Ebonyi State Ministry of Agriculture implemented climate-resilient agricultural projects to support local farmers. The Institute for Agricultural Research (IAR) and the International Institute of Tropical Agriculture (IITA) conducted research and provided support for the dissemination of CSA practices. The Federal Ministry of Agriculture and Rural Development (FMARD) also played a role in scaling up CSA practices through initiatives such as the Agricultural Transformation Agenda (ATA) (Adebayo et al., 2022; IITA, 2020).

Furthermore, international organisations like the Food and Agriculture Organization (FAO) of the United Nations supported Nigeria's CSA efforts through projects aimed at strengthening climate-resilient agriculture. A recent report by the FAO highlighted the positive effects of CSA practices on agricultural productivity and greenhouse gas emissions reduction in Ebonyi State (FAO, 2022). Additionally, the Ebonyi State Government established the Ebonyi State Climate Smart Agriculture, which prioritised the practice of CSA techniques in agricultural development (Ebonyi State Government, 2020).

Overall, this study aimed to provide a comprehensive understanding of the practice and effect of CSA techniques among cassava farmers in Ebonyi State. By examining the factors that influence the practices and reviewing the efforts of various organisations, the study identified effective strategies for promoting CSA and enhancing the resilience of the agricultural sector to climate change. Continued support and research were essential to maximise the benefits of CSA practices and ensure sustainable agricultural development in Ebonyi State (Okoro et al., 2022; Nwankwo et al., 2022).

The study assessed the effects of climate-smart agricultural practices on cassava farmers' output in Ebonyi State, Nigeria by addressing the following specific objectives: identify the climate-smart agricultural practices used by cassava farmers; examine the challenges cassava farmers encounter in implementing these practices, and; assess the effect of climate-smart agricultural practices on cassava farmers' output.

Methodology

The study was conducted in Ebonyi State, Nigeria. Ebonyi State is located between latitude 6.26490°N and longitude 8.01370°E (Figure 1), with an estimated population of 3,398,177 persons (National Bureau of Statistics (NBS), 2020). Ebonyi State has a humid tropical climate, characterized by one rainy season lasting eight months and one dry season lasting four months. During the dry season, temperatures range from 20 to 38 degrees Celsius, while during the rainy season, they range from 16 to 28 degrees Celsius. Harmattan winds are common between December and January. The average annual temperature is 28 degrees Celsius, and the average annual humidity is 50-60%. The region receives an average annual precipitation of 2500mm, indicating that the state experiences significant climate variations (Climate-Data.org, 2022; Scientific Diagram, 2023). The economy of Ebonyi State is primarily centred on agriculture, with the main crops being yam, rice, oil palm, and cassava.

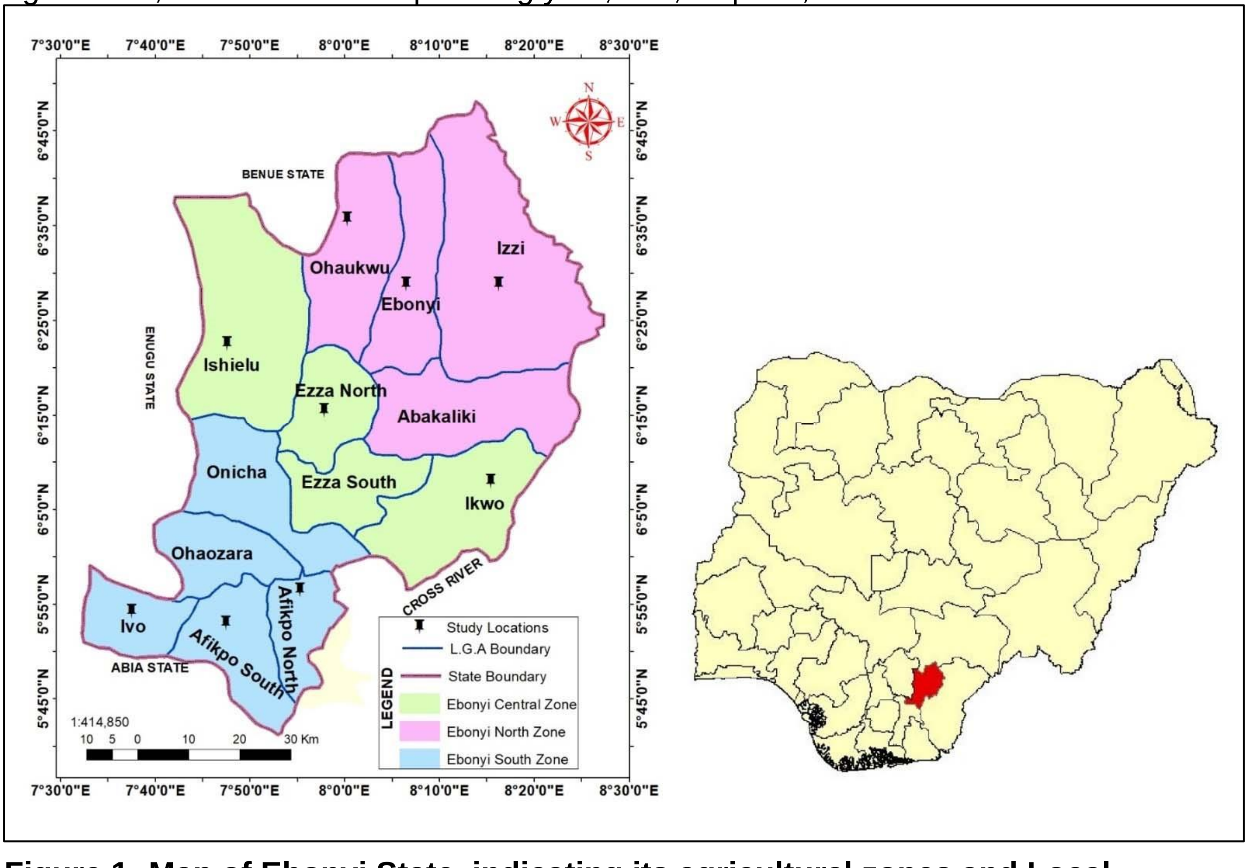

Figure 1: Map of Ebonyi State, indicating its agricultural zones and Local Government Areas (LGAs). (Scientific Diagram. (2023))

The study employed a cross-sectional survey design with a multi-stage sampling procedure for selecting respondents. In the first stage random sampling technique was used to select two agricultural zones in the state, specifically Ebonyi North and Ebonyi South. In the second stage, two Agricultural Development Programme (ADP) blocks were selected from the three blocks that made up each zone using simple random technique, resulting in four blocks. The third stage involved selecting three circles from each of the blocks using simple random technique, leading to twelve circles. Finally, a proportionate sampling procedure was applied, where seventy-five percent of cassava farmers were selected from each of the circles, resulting in a total of 120 respondents.

Data were collected using a structured questionnaire. Percentages were used to analyse Objectives 1 and 2, while correlation coefficient analysis was used to analyse Objective 3. To operationalize climate-smart agricultural practices, data was collected on 13 listed practices. Respondents selected multiple practices, enabling them to indicate all the practices they used. The practice rates were calculated as the percentage of farmers who reported using each practice. The practices were then ranked according to their percentages. For challenges in adopting climate-smart agricultural practices, the prevalence of each challenge was calculated in percentage, and ranked based on the percentage. To assess the effects of climate-smart agricultural (CSA) practices on output, each farmer's use of specific CSA practices was scored as 1 (used) or 0 (not used). The practices included early planting, mixed cropping, ridging/furrows, timely weeding, cover crops, improved planting materials, organic manure, mulching, contour terracing, agroforestry, irrigation, disease-resistant varieties, and minimum tillage. Farmers' scores across all practices were summed to create a composite score, reflecting their overall use of CSA practices. This composite score was then used to analyse the relationship between the level of CSA practices and cassava output.

Results and Discussion

Climate-Smart Agricultural Practices Adopted

Table 1 shows the usage of climate-smart agricultural practices among farmers in Ebonyi State, Nigeria. The practices that were ranked highest were: early planting (100.00%), mixed cropping (90.00%), and ridging/furrows (89.17%). These practices are pivotal in addressing climate change challenges by optimizing crop growth periods, enhancing soil health through diversified planting methods, and improving water management via effective soil moisture retention techniques. Early planting stands out with a 100% adoption rate, highlighting its critical role in mitigating climate variability and enhancing yield stability by aligning crop growth with optimal weather conditions, as emphasized by Santalucia (2023). Similarly, Vatsa et al. (2023); Omotoso and Omotayo (2024) underscore how mixed cropping and ridging/furrows improve soil structure, nutrient cycling, and water infiltration, essential for sustainable agriculture in changing climates. These findings underscore the significance of promoting these practices to bolster agricultural output and resilience amidst ongoing climate uncertainties.

Table 1: Climate-smart agricultural practices adopted

Variables	Percentage (n=120)

Early planting	100.00
Mixed cropping	90.00
Ridging/furrows	89.17
Timely weeding	88.33
Use of cover crops	68.33
Use of improved planting materials	60.83
Use of organic manure	57.50
Mulching	55.83
Contour terracing	45.00
Agroforestry	36.67
Irrigation	35.83
Use of disease-resistant varieties	34.17
Minimum tillage	25.00

Source: Field survey, 2024. * Multiple responses recorded

Challenges in Adopting Climate-Smart Agricultural Practices

Table 2 shows the primary challenges faced by farmers in Ebonyi State, Nigeria, regarding the adoption of climate-smart agricultural practices. The major challenges include lack of credit (78.33%), land fragmentation (75.00%) and high cost of labour (70.00%).

Lack of credit was the foremost obstacle, with over three-quarters of farmers citing it as a barrier to adopting climate-smart practices. This challenge hinders farmers' ability to invest in technologies and inputs that enhance climate resilience and productivity (Akter et al., 2022). Land fragmentation follows closely, with 75.00% of farmers indicating its impact. Fragmented land holdings complicate the implementation of integrated practices like agroforestry and contour terracing, which require coordinated land use planning and management (Diro et al., 2022). Additionally, the high cost of labour (70.00%) underscores financial constraints faced by farmers in hiring labour for timely practices such as weeding and mulching, crucial for maintaining soil health and crop productivity (Kangogo et al., 2021).

This study corroborates previous findings, emphasizing the multifaceted nature of barriers to CSA adoption in agricultural contexts similar to Ebonyi State. For instance, Akter et al. (2022) discuss how financial constraints limit farmers' access to credit, thus hindering their capacity to invest in sustainable agricultural practices. Diro et al. (2022) highlighted the implications of land fragmentation on agricultural productivity and the challenges it poses for implementing sustainable land management practices. Moreover, Kangogo et al. (2021) underlined the impact of labour costs on smallholder farmers, affecting their ability to adopt labour-intensive climate-smart practices.

Table 2: Challenges in adopting climate-smart agricultural practices

Variables	Percentage
Lack of credit	78.33
Land fragmentation	75.00
High cost of labour	70.00
High cost of transportation	67.50
Lack of formal education	64.17

Source: Field survey, 2024: * multiple responses recorded

Effects of Climate-Smart Agricultural Practices on Output

Table 3 shows the effects of climate-smart agricultural practices on farmers' output. A significant correlation coefficient was found between Climate-Smart Agricultural Practices (CSA) and agricultural output (0.3131). This correlation suggests that as farmers adopt more CSA practices, there is a corresponding increase in agricultural output, indicating a positive relationship. Recent studies support this finding, emphasizing the beneficial impact of CSA practices on agricultural output. Santalucia (2023) underscores that adopting climate-smart techniques can lead to improved crop yields and resilience to climate variability. Similarly, Vatsa et al. (2023) and Omotoso and Omotayo (2024) highlight how practices such as early planting, mixed cropping, and soil conservation methods enhance soil health and optimize resource use, thereby boosting agricultural output.

Table 3: Effects of climate-smart agricultural practices on output

Variable with Output	Mean	Std. Dev	Min	Max	Correlation
Climate-Smart Agricultural Practices	0.65	0.24	0	1	0.3131***
Output (kg/ha)	900	200	500	1500	-

Source: Field Survey Data, 2024. ***: Significant at 1% level.

Conclusion and Recommendations

In conclusion, this study revealed that major barriers such as lack of credit, land fragmentation, and high labour costs hinder their widespread use of climate smart agricultural practices. Nevertheless, the use of Climate-Smart Agricultural (CSA) practices positively affects agricultural output, thus enhancing resilience to climate change and improving output and food security. Addressing these challenges effectively requires targeted interventions, including improving access to credit facilities, promoting land consolidation initiatives, and introducing mechanisation options to alleviate financial burdens and enhance climate resilience among farmers. Finally, continued support and implementation of these practices are crucial for ensuring sustainable agricultural development.

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