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ASSESSING ADAPTIVE CAPACITY OF OIL PALM FARMERS FOR CLIMATE CHANGE-INDUCED SHOCK ADAPTATION IN ABIA STATE, NIGERIA

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ABSTRACT

The study assessed the adaptive capacity of oil palm farmers in Abia State, Nigeria, to climate change-induced shocks. Using a multi-stage sampling approach, data were collected from 179 farmers through a structured questionnaire. Key focus areas included the occurrence of climate-related shocks, farmers' adaptive capacity, knowledge of sustainable strategies, and challenges faced. Analysis using a Likert-type scale revealed that farmers frequently experienced erratic rainfall (3.77), extreme temperatures (3.50), pests and diseases (3.20), heatwaves (3.12), and droughts (3.00). High levels of adaptive capacity were noted, particularly in the use of traditional knowledge (3.59) and risk management strategies (3.34). Farmers also demonstrated strong knowledge of soil conservation techniques (4.00), soil fertility management (3.88), water management (3.58), and integrated pest management (3.50), indicating their preparedness to mitigate climate impacts. However, major constraints affecting adaptation efforts included land tenure issues (4.66), inadequate capital (4.75), and poor financial status (4.58). Correlation analysis showed a significant positive relationship (r = 0.3743, p < 0.05) between adaptive capacity and farmers' knowledge of mitigation strategies, suggesting that better-informed farmers are more capable of managing climate risks. The study concludes by advocating for improved access to climate information, continuous training (especially for women), stronger collaboration among stakeholders, and policies that enhance access to land and other production resources. These measures are essential for boosting the sustainability, productivity, and resilience of oil palm farming in the face of climate change.

Keywords: oil palm production, adaptation capacity, climate change

INTRODUCTION

Climate change presents significant challenges to agricultural systems worldwide, especially those dependent on oil palm cultivation. In Nigeria, where oil palm farming is a key economic activity, the effects of climate change-induced shocks on the agricultural sector are of great concern (Abubakar, Gambo, and Ishak, 2023). The adaptive capacity of farmers refers to their ability to adjust and respond effectively to shifting environmental conditions, including those caused by climate change. Assessing this adaptive capacity is crucial for understanding the resilience of agricultural systems and developing suitable strategies for adaptation. Evaluating farmers' adaptive capacity is particularly relevant given the increasing frequency and severity of climate-related events, such as erratic rainfall patterns, droughts, floods, and rising temperatures (Abubakar et al., 2022).

Oil palm production holds significant economic importance in Nigeria, contributing to both domestic consumption and export earnings. Nigeria is one of the leading producers of oil palm globally, and the sector plays a crucial role in the country's agricultural landscape and rural development (Qaim et al., 2020). Abia State, located in southeastern Nigeria, is among the key regions driving oil palm production, with its favorable agro-climatic conditions and vast arable land suitable for cultivation.

The sector serves as a major source of revenue for both the government and individual farmers through the sale of palm oil, palm kernel, and related products in domestic and international markets. Abia State is renowned for its prominence in oil palm production within Nigeria. The state boasts of favorable agro-climatic conditions, including adequate rainfall and fertile soils, conducive to oil palm cultivation. Abia State's oil palm plantations, primarily located in rural areas, significantly contribute to the state's economy and offer employment opportunities for rural residents. Climate change-induced shocks pose significant challenges to oil palm farmers worldwide, affecting their livelihoods, agricultural productivity, and overall well-being. Oil palm cultivation, a vital economic activity in many tropical regions, is particularly vulnerable to the impacts of climate change due to its sensitivity to temperature, rainfall patterns, and extreme weather events (Oktarina, Nurkhoiry, and Pradiko 2021). Among oil palm farmers, climate change-induced shocks manifest in various forms, including but not limited to erratic rainfall patterns, droughts, floods, temperature extremes, storms, and cyclones.

These climate change-induced shocks have profound implications for oil palm farmers, affecting their income, food security, and resilience to future climatic risks. In addition to direct impacts on agricultural production, these shocks can also exacerbate socio-economic disparities, disrupt local economies, and undermine the sustainability of oil palm farming systems. Addressing the challenges posed by climate change-induced shocks requires a multi-faceted approach, integrating climate adaptation strategies, risk management measures, and support mechanisms tailored to the specific needs and vulnerabilities of oil palm farmers (Abubakar et al., 2021). By understanding the nature and impacts of these shocks, policymakers, researchers, and stakeholders can work collaboratively to develop effective solutions that enhance the resilience and sustainable agricultural development, ensuring food security and fostering resilience in vulnerable communities. Sustainability of oil palm farming communities in the face of climate change.

Farmers' ability to adapt to changing environmental conditions depends on their capacity to innovate, experiment, and implement new practices. Flexible farming systems, diversified crops, and mixed livestock-agroforestry systems enhance resilience by spreading risks and minimizing dependence on single crops or income sources. Innovation in sustainable agricultural practices, such as conservation agriculture, agroecology, and precision farming, improves resource use efficiency, soil health, and crop productivity. Farmers' adaptive capacity is strengthened by their ability to anticipate, assess, and manage climate-related risks. Risk assessment tools, early warning systems, and climate forecasting services enable farmers to make timely decisions and mitigate potential losses. Adaptive planning, including crop diversification, crop rotation, and seasonal forecasting, enhances resilience by spreading risks across different time frames and spatial scales. Effective governance structures, policies, and institutions play a crucial role in enhancing farmers' adaptive capacity. Supportive policies, subsidies, and incentives promote the adoption of climate-smart practices and technologies, while regulatory frameworks ensure the sustainability of agricultural production and natural resource management. Strengthening local institutions, extension services, and farmer organizations fosters collaboration, knowledge-sharing, and collective action for adaptation.

Against this backdrop, building farmers' adaptive capacity is essential for promoting resilience, sustainability, and food security in the face of climate change. By addressing knowledge gaps, improving access to resources, fostering innovation, promoting risk management, and strengthening governance, policymakers, researchers, and stakeholders can empower farmers to adapt and thrive in a changing climate. Investing in farmers' adaptive capacity not only benefits agricultural productivity and livelihoods but also contributes to broader development goals, including poverty reduction, environmental conservation, and social equity. Hence, this research underscores the importance of understanding and enhancing the adaptive capacity of oil palm farmers in Abia State, Nigeria, to mitigate the adverse effects of climate change on agricultural productivity, livelihoods, and food security. By addressing the challenges faced by farmers and promoting sustainable adaptation measures, this study aims to contribute to the resilience and sustainability of oil palm farming systems in the region, ultimately benefiting both farmers and the broader society.

Objectives of the Study: ascertain occurrences of climate change-induced shocks and incidents experienced by farmers; assess the adaptive capacity of oil palm farmers to climate change-induced challenges; examine the knowledge level of farmers regarding potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change-induced shocks; and identify the major challenges and constraints facing oil palm farmers in Abia State.

METHODOLOGY

STUDY AREA

The study was carried out in Abia State, Nigeria. Abia State comprises 17 Local Government Areas (LGAs) divided into three agricultural zones. The total land area of Abia State is 4,900 Km^2 (Wikipedia, 2021). The State has a population density of 580 persons per square kilometer and a population of 3,727,300 persons (NPC, 2010).

Men and women are involved in agricultural production in the study area. Impacts of climate change, such as drought, floods, extreme weather events, and reduced food and water security, affect farmers. Abia State serves as an important study area for investigating the dynamics of oil palm production and its response to climate change, offering a rich context for understanding the complexities of agricultural adaptation, environmental sustainability, and rural development in Nigeria's oil palm belt.

SAMPLING PROCEDURE

The population of the study comprised all individuals or households engaged in oil palm cultivation within Abia State. This included both smallholder farmers operating on relatively small plots of land and larger-scale commercial plantations spread across the state's diverse geographical and socio-economic landscapes. A proportional stratified sampling procedure was used to select sample respondents. Oil palm Farmers Association of Nigeria, Abia State chapter has on record 1785 registered active members across different agricultural Zones of the State. The study, however, proportionately sampled 10% of these strata (50 from Aba, 108 from Ohafia, and 21 from Umuahia) to give a total of 179 oil palm farmers for the study.

MEASUREMENT OF VARIABLES AND MODEL SPECIFICATIONS

Climate change-induced shocks/incidents (natural hazards) experienced by oil palm farmers in the last five years

Climate change-induced shocks/incidents (natural hazards) were listed (and updated during the pre-testing survey). Farmers were required to indicate where applicable to them or the ones they have experienced within the last five years. Data were analyzed using the mean score. Responses from the five-point rating scale of VF= very frequently (5), A= Always (4), U= Undecided (3), S= sometimes (2), N= Never (1) were used to calculate the mean scores. Variables with a mean score of 3.0 (which is the average mean score of the Likert type level) and above imply that they are positive and in affirmative with the objective being measured, while factors with a mean score of less than 3.0 are negative and rarely have influence on the objective being measured. To determine the mean Likert level $\sum X/N$. mean of each item was computed by multiplying the frequency of each response pattern by its appropriate nominal value and dividing the sum by the number of respondents to the items.

The level of adaptive capacity of oil palm farmers to climate change-induced shocks

The level of adaptive capacity of oil palm farmers to climate change-induced shocks was realized using mean count. 5-point Likert-type scale of Very High (5), High (4), Moderate (3), Low (2), and Very Low (1) were used to achieve the mean. Variables with a mean score of 3.0 (which is the average mean score of the Likert level) and above imply that they are positive and in affirmative with the objective being measured, while factors with a mean score of less than 3.0 are negative and rarely have influence on the objective being measured.

Knowledge level of farmers on potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change induced shocks

knowledge level of farmers on potential strategies for enhancing sustainability, productivity, and resilience of oil palm production against climate change induced shocks, were realized using a five-point Likert scale of strongly agree (5), agree (4), neutral (3), disagree (2), strongly disagree (1) with a midpoint of 3.00. The decision rule is that mean scores of 3.00 and above imply that the farmers agree with the knowledge statements expressing their level of on potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change induced shocks, while mean scores of less than 3.00 indicate disagreement.

Challenges and constraints facing oil palm farmers in Abia State

Major challenges and constraints facing oil palm farmers in Abia State were captured using a four-point Likert-type scale of strongly agree (4), agree (3), disagree (3), and strongly disagree (1). Based on the weights assigned, a midpoint of 2.50 was obtained. The decision rule is that a mean score of 2.50 and above indicates agreement with the statement, while a mean score of less than 2.50 posits disagreement with the statement.

Table 1: Analysis of the occurrence of climate change-induced shocks/incidents experienced by farmers

Items	VF	A	U	S	N	Mean
Erratic Rainfall Patterns	24(120)	116(464)	12(36)	27(54)	0(0)	3.77
Droughts	0(0)	91(364)	21(63)	43(86)	24(24)	3
Floods	34(170)	78(312)	16(48)	44(88)	7(7)	3.49
Heatwaves	0(0)	71(284)	65(195)	36(72)	7(7)	3.12
Extreme Temperatures	7(35)	112(448)	28(84)	28(56)	4(4)	3.5
Pests and Diseases:	0(0)	105(420)	8(24)	62(124)	4(4)	3.2
Wildfires:	4(20)	3(12)	54(162)	77(154)	41(41)	2.17

Source: Field survey, 2024
Figures in parentheses are the weighted frequency values
Benchmark mean =3.00
VF= Very Frequently (5), A= Always (4), U=Undecided (3), S= Sometimes (2), N= Never (1)

Level of adaptive capacity of oil palm farmers to adapt to climate change-induced shocks

Farmers' adaptive capacity is crucial in adapting to climate change, particularly in Southeast Nigeria, where fluctuations and variability are expected. The level of adaptive capacity of oil palm farmers to climate change-induced shocks was presented in Table 3. The results showed that there was a high adaptive capacity of farmers to climate change-induced shock on **traditional knowledge and practices** (3.59), **knowledge and awareness** (3.40), and **risk management strategies** (3.34).

The higher mean score from traditional practices as an adaptive measure was in line with Omotayo et al., (2020), who observed the use of traditionally adaptive techniques to reduce their susceptibility to climate-induced challenges. These traditional practices include planting shade trees to reduce heat stress on oil palms, maintaining buffer zones to prevent flooding, and relying on indigenous knowledge to predict weather patterns. Farmers often rely on community-based knowledge-sharing systems to disseminate best practices for managing the impacts of climate variability (Omotayo et al., 2020). Adesina et al., (2020) noted that there exist efforts on the adoption of digital tools, such as weather forecasting apps, which allow farmers to make better-informed decisions about planting and harvesting times based on real-time climate data.

However, the study found low capacity on the access to resources, adequate access to financial resources, agricultural inputs and technology is crucial for implementing adaptive measures (2.23), **social Networks and Institutions, s**trong social networks, community-based organizations, and farmer groups play a vital role in disseminating information, sharing knowledge, and facilitating collective action for adaptation (2.63), **infrastructure and technology, a**ccess to appropriate infrastructure and technology, such as irrigation systems, weather forecasting tools, and farming equipment, can improve farmers' resilience to climate change impacts (2.68) and **policy support and governance, p**olicies promoting sustainable land management, conservation agriculture, and climate-smart farming practices can enhance adaptive measures farmers' resilience to climate change impacts (2.50) with the mean scores below 3.00 benchmark mean.

Table 2: Level of adaptive capacity of oil palm farmers to climate change-induced shocks adaptation

Item	VH	H	M	L	VL	Mean
Knowledge and Awareness	16(80)	77(308)	49(147)	37(74)	0(0)	3.40
Access to Resources	16(80)	4(16)	31(93)	82(164)	46(46)	2.23
Social Networks and Institutions	4(20)	38(152)	40(120)	81(162)	16(16)	2.63
Risk Management Strategies	4(20)	95(380)	41(123)	36(72)	3(3)	3.34
Infrastructure and Technology	12(60)	34(136)	32(96)	86(172)	15(15)	2.68
Traditional Knowledge and Practices	15(75)	83(332)	73(219)	8(16)	0(0)	3.59
Policy Support and Governance	12(60)	4(16)	58(174)	93(186)	12(12)	2.50

Source: Field survey, 2024
Figures in parentheses are the weighted frequency values
Benchmark means =3.00
VH= Very High (5), H= High (4), M=Moderate (3), L= Low (2), VL= Very Low (1

Knowledge level of farmers on potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change-induced shocks

The study assessed the knowledge of oil palm farmers in Abia State, Nigeria, on sustainable strategies for mitigating climate change-induced shocks. Results from Table 4 indicated a high level of awareness and knowledge among farmers on key adaptive practices. These included soil conservation techniques such as mulching and cover cropping (4.00), soil fertility enhancement through composting and green manure (3.88), water management practices like drip irrigation and rainwater harvesting (3.58), and integrated pest management (IPM) (3.50). These mean scores exceeded the study's benchmark of 3.00, indicating widespread adoption and understanding of these practices among respondents. These findings align with Ferreira (2023), who emphasized the dual role of mulching in retaining soil moisture and preventing root diseases caused by excess water. Abdulraheem et al. (2021) also confirmed the importance of mulching for soil fertility and pest control. Abubakar et al. (2021) highlighted additional traditional adaptation strategies, including silt pit trenches, mixed cropping, zero-burning methods, improved varieties, and sustainable pest control, all of which reinforce the study's results.

The study also revealed strong knowledge in sustainable land use planning (3.44), agroforestry systems (3.32), and the use of climate-resilient varieties and mixed cropping techniques (3.40). These approaches support ecological balance and reduce the risk of climate-related crop failure. According to Gollin et al. (2021), such innovations, including high-yield and disease-resistant varieties, are essential for enhancing resilience and productivity in oil palm cultivation. Ojong et al. (2023) further supported the role of climate-smart agriculture in achieving food security, resilience, and lower greenhouse gas emissions.

Obi et al. (2022) affirmed the value of IPM as a comprehensive pest control approach that combines biological methods, rotation, and judicious pesticide use, contributing to environmental protection and sustainable farming. Overall, the high level of knowledge among farmers underscores the role of agricultural extension, farmer training, and community-driven practices in enhancing climate resilience, boosting food security, and empowering rural oil palm communities.

Table 3: Analysis of the level of knowledge of potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change-induced shocks

Item	SA	A	U	D	SD	Mean
I am knowledgeable about water management strategies, such as drip irrigation and rainwater harvesting, that can help address water scarcity and drought stress in oil palm cultivation.	20(100)	109(436)	4(12)	46(92)	0(0)	3.58
I am aware of climate-smart agricultural practices that can help mitigate the impacts of climate change on oil palm production.	15(75)	65(260)	61(183)	38(76)	0(0)	3.32
I understand the importance of soil conservation techniques, such as cover cropping and mulching, in improving soil health and moisture retention in oil palm plantations.	8(40)	163(652)	8(24)	0(0)	0(0)	4
I am familiar with the concept of integrated pest management (IPM) and biological control methods for managing pests and diseases in oil palm plantations, reducing reliance on chemical pesticides.	0(0)	117(468)	46(138)	4(8)	12	3.5
I have knowledge of climate-resilient oil palm varieties and planting techniques, such as staggered planting and mixed cropping, to minimize the risk of crop failure and increase yield stability.	7(35)	66(264)	98(294)	8(16)	0(0)	3.4
I am familiar with the principles of sustainable land use planning, agroforestry design, and landscape management for promoting resilience and ecological balance in oil palm landscapes.	8(40)	90(360)	53(159)	38(56)	0(0)	3.44
I am aware of the importance of maintaining soil fertility through organic matter addition, composting, and green manure incorporation to support healthy oil palm growth and productivity."	3(15)	160(640)	8(24)	8(16)	0(0)	3.88

Source: Field survey, 2024
Figures in parentheses are the weighted frequency values
Benchmark mean =3.00

Note: Strongly agree (SA) =5, Agreed (A) =4, Undecided (U) = 3, Disagree (D) =2, strongly disagree (SD) =1

Major challenges and constraints facing oil palm farmers in Abia State,

The results in Table 4 showed that land tenure issues (4.66), inadequate capital (4.75), poor Infrastructure (4.60) and poor financial status of the farmers/processors (4.58) were the majority 1st to fourth challenges faced by the oil palm producers in the study are with the mean scores of 4.00 and above, the benchmark mean of 3.00. In line with the findings, Umeh *et al.*[b] (2020) noted that farm size is a major determinant of the speed of adoption of adaptation measures to climate change.

However, Umeh *et al.*[a] (2020) noted lack of money is a major constraint to adaptation by farmers. Arguing that rural farmers are generally poor, do not have adequate technology, related skills, and cannot afford to invest in technologies to adapt to climate change or sustain their livelihood during harsh climate conditions such as drought (Sofoluwe et al., 2011; Alam et al., 2011).

Table 4: Analysis of Constraints militating against the adoption of CSA practices

Constraints	SA	A	U	D	SD	Mean
Land Tenure Issues	135675)	32(128)	8(16)	4(8)	0(0)	4.66
Inadequate capital	151(755)	12(48)	16(48)	0(0)	0(0)	4.75
Poor Infrastructure	139(695)	16(64)	16(48)	8(16)	0(0)	4.6
Harvesting, processing, and storing Technologies were against your cultural or religious beliefs	3(15)	12(48)	8(24)	4(8)	152(152)	1.38
Difficulty in applying technology	15(75)	128(512)	20(60)	16(32)	0(0)	3.79
Lack of technical support	27(135)	132(528)	12(36)	8(16)	0(0)	3.99
Poor access to information from extension agents	35(175)	119(475)	9(27)	8(16)	8(8)	3.92
Poor financial status of the farmers/processors	131(655)	32(128)	8(24)	4(16)	4(4)	4.58
Environmental Degradation	27(135)	136(544)	8(24)	4(16)	4(4)	3.99
Irregular and weak government policies	63(315)	59(236)	10(30)	18(36)	29(29)	3.61

Source: Field survey, 2024
Figures in parentheses are the weighted frequency values
Benchmark means =3.00
Note: Strongly agree (SA) =5, Agreed (A) =4, Undecided (U) = 3, Disagree (D) =2, strongly disagree (SD) =1

However, the constraints such as lack of technical support and environmental degradation (3.99), poor access to information from extension agents (3.92) and difficulty in applying technology (3.79) were also identified as major challenges. However, technology is one of the crucial factors to adapt to climate changes (Alam et al., 2011). Poor agricultural information dissemination and lack of skill in technology applications were also observed by Ojemade et al., (2019).

Hypothesis

Significant relationship between the adaptive capacity of oil palm farmers to climate change-induced shocks adaptation, and the knowledge level of farmers on potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change-induced shocks

Table 5 shows the correlation analyses of adaptive capacity of oil palm farmers to climate change-induced shocks adaptation, and knowledge level of farmers on potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change-induced shocks. The results showed that there was a positive (r = 0.3743) correlation between the market adaptive capacity of oil palm farmers to climate change-induced shocks adaptation and the knowledge level of farmers on potential strategies for enhancing sustainability, productivity, and resilience of oil palm production against climate change-induced shocks at a 5% level of probability.

This implied that there was a strong relationship between the adaptive capacity of oil palm farmers to climate change-induced shocks, adaptation, and the knowledge level of farmers on potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change-induced shocks. It further implied that an increase in the adaptive capacity of oil palm farmers to climate change-induced shocks will increase the knowledge level of farmers on potential strategies for enhancing the sustainability, productivity, and resilience of oil palm production against climate change-induced shocks by approximately 37% and vice versa.

Table 5: Correlation Coefficient of the level of adaptive climate change capacity usage and the level of knowledge on potential climate change strategies

Variables	Level of knowledge	Level of utilization
Level of knowledge on climate change-induced shock strategies	1.0000	
Level of utilization of adaptive climate change-induced shock	0.3743 (0.0028)	1.0000

Source: STATA 13 Results. * is statistically significant at 5%.

CONCLUSION AND RECOMMENDATIONS

The study provided an empirical assessment of the adaptive capacity of oil palm farmers for climate change-induced shock adaptation in Abia State, Nigeria. Interestingly, farmers are already implementing adaptation measures such as soil conservation, water management, and integrated pest management to mitigate the impacts of erratic rainfall, extreme temperatures, and pests. They also rely on traditional knowledge and risk management strategies. However, major constraints such as insecure land tenure, limited capital, and poor infrastructure hinder their full adaptive potential.

To enhance resilience, food security, and community empowerment, the study recommends collaborative efforts among stakeholders, including farmers, the government, extension agents, the private sector, and NGOs. Continuous training, workshops, and access to improved technologies and climate-resilient oil palm varieties are vital. Strengthening extension services and rural infrastructure, alongside inclusive policies, will empower farmers to adopt sustainable practices, improve productivity, and build long-term resilience in the face of climate change.

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