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EFFECT OF CLIMATE CHANGE ON RURAL LIVELIHOODS AND ADAPTATION STRATEGIES EMPLOYED BY SMALLHOLDER FARMERS IN RIVERS STATE

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ABSTRACT

Climate change poses significant threats to rural livelihoods, particularly for smallholder farmers who rely solely on agriculture for their sustenance and economic stability. The study assessed the effects of climate change on rural livelihoods in Rivers State, Nigeria, focusing on the challenges faced by smallholder farmers, the adaptation strategies employed to mitigate these impacts, and the effectiveness of existing governmental and non-governmental support mechanisms for assisting smallholder farmers in adapting to climate change. Utilizing a mixed-methods approach, the research combines quantitative data from surveys with qualitative insights from interviews and focus group discussions (FGD). Key findings reveal that smallholder farmers in Rivers State were experiencing altered rainfall patterns (Mean = 3.60), increased temperatures, and heightened incidence of extreme weather conditions (Mean = 3.50), among other factors, which adversely affect crop yields and livestock productivity. In response to these challenges, the study further revealed that farmers in the study area have adopted various adaptation strategies, including diversifying crop varieties (Mean = 3.70), implementing sustainable agricultural practices, and utilizing improved irrigation techniques (Mean = 3.50). The study revealed that there was not much support mechanism by government and non-governmental organisations in the study area. Thus, the study recommended, among others, the need for government and non-governmental organisations to develop a functional support mechanism to cushion the effects of climate change on rural livelihoods in the study area.

Keywords: Adaptation, Climate change, Rural livelihoods.

1. INTRODUCTION

Climate change is increasingly recognized as a critical global challenge that poses significant risks to agriculture and rural livelihoods, particularly in developing countries. Smallholder farmers, who constitute a substantial portion of the agricultural workforce in regions like Rivers State, Nigeria, are particularly vulnerable to the adverse effects of climate variability. These farmers often lack the resources and adaptive capacity needed to cope with changing environmental conditions, which can lead to decreased agricultural productivity and increased food insecurity (IPCC, 2021).

Recent studies have documented the various ways in which climate change impacts agricultural systems. For instance, Oluoch-Kosgey et al. (2022) highlight that altered rainfall patterns and rising temperatures directly affect crop yields and livestock health, exacerbating existing vulnerabilities among smallholder farmers. In Rivers State, these changes manifest as

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unpredictable weather events, including prolonged droughts and intense flooding, which disrupt traditional farming practices and threaten the livelihoods of rural communities (Nwankwo et al., 2023).

In response to these challenges, many smallholder farmers are adopting a range of adaptation strategies to enhance their resilience. According to Adebayo et al. (2023), these strategies include diversifying crop varieties, utilizing improved irrigation methods, and incorporating sustainable agricultural practices that promote soil health and water conservation. The role of local knowledge in shaping these adaptive measures cannot be overstated; community-based approaches often provide valuable insights into effective coping mechanisms tailored to specific local conditions (Moges et al., 2023).

Despite the critical importance of these adaptation strategies, there remains a significant gap in support from governmental and non-governmental organizations that could empower smallholder farmers in their efforts to combat climate change (Ojo et al., 2023). This study aims to explore the impact of climate change on rural livelihoods in Rivers State, Nigeria, focusing on the challenges faced by smallholder farmers and the adaptation strategies employed. By examining these dynamics, the research seeks to contribute to a deeper understanding of how climate change intersects with rural livelihoods and inform policy recommendations for enhancing resilience in vulnerable agricultural communities such as in the study area.

Purpose of the Study

The general objective of this study is to assess the effect of climate change on rural livelihoods and adaptation strategies employed by smallholder farmers in Rivers State. Thus, the specific objectives include;

i. assess the effects of climate change on rural livelihoods in the study area
ii. to identify challenges faced by smallholder farmers in mitigating climate change in the study area
iii. determine the adaptation strategies employed to mitigate the impacts of climate change on rural livelihoods, and
iv. to assess the effectiveness of existing governmental and non-governmental support mechanisms aimed at assisting smallholder farmers in adapting to climate change.

2. METHODOLOGY OF THE STUDY

Rivers State, located in the Niger Delta region of Nigeria, is characterized by its rich biodiversity, extensive river systems, and a predominantly rural population engaged in agriculture, fishing, and other natural resource-dependent livelihoods. The State is bordered by the Atlantic Ocean to the south and features a network of rivers, including the famous River Niger and its tributaries. Rivers State covers an area of approximately 11,077 square kilometres and has a population of over 7,034,973 people, with a significant portion living in rural areas (National Bureau of Statistics, 2020). The economy is largely driven by oil and gas production, but many rural communities rely on subsistence farming and fishing for their livelihoods. The climate in Rivers State is tropical, characterized by high humidity and rainfall, with two distinct seasons: the wet season (April to October) and the dry season (November to March) (Nwankwoala et al., 2015). The region is prone to flooding, particularly during the rainy season, which can severely impact agricultural activities and rural livelihoods. Two hundred smallholder farmers were selected for this study using a multi-stage sampling technique, conducted in three

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stages. In stage one, four local government areas were randomly selected from the twenty-three local government areas that make up the State. The second stage comprises of the random selection of five Communities in each of the selected four LGAs, which gave a total of twenty communities. Lastly, ten (10) smallholder farmers were purposively selected from each of the selected twenty (20) communities, which gave a total of two hundred (200) respondents used for the study. Data was collected with the aid of a structured questionnaire, focus group discussion (FGD), and analysed using descriptive statistics, namely, mean, frequency count, and percentages. Climate change impacts were captured using a 16-item statement rated on a four-point Likert-type scale with values of strongly agree = 4; agree = 3; disagree = 2; strongly disagree = 1. A midpoint of 2.50 was obtained, and based on this, the decision rule was that any mean score greater than or equal to 2.50 implies agreement with the climate change effects, and any mean score less than 2.50 implies disagreement with the effects. The climate change effect was dichotomized into agree and disagree.

3. RESULTS AND DISCUSSION

Table 1: Effects of climate change on rural livelihoods

Perceived climate change-related effect	Mean	Remarks
Increased temperatures and heightened incidences of extreme weather conditions	3.50	Agree
Altered rainfall patterns and increased erosion degrade soil quality and fertility.	3.60	Agree
Warmer temperatures increase the prevalence of pests and diseases that affect crops and livestock.	3.40	Agree
Changes in rainfall and increased evaporation led to water scarcity for irrigation and livestock.	3.20	Agree
Climate change altered the length and timing of growing seasons, affecting planting and harvest times.	3.50	Agree
Increased frequency of droughts, floods, and storms can damage crops and infrastructure.	3.40	Agree
Heat stress and changing disease patterns can negatively impact livestock health and productivity.	3,10	Agree
The reduced crop yields and increased prices lead to food shortages and higher costs for smallholder farmers.	3.00	Agree
Climate-related disruptions hinder transportation and access to markets, affecting sales and income.	3.40	Agree
Changes in climate threatens local biodiversity, affecting crop diversity and resilience.	2.95	Agree
The stress associated with climate impacts on farming lead to stunted growth in crops	2.90	Agree
Women, who often play key roles in smallholder farming, face greater challenges due to climate impacts, exacerbating gender inequalities.	2.90	Agree
Deteriorating conditions force farmers to migrate in search of better opportunities, disrupting communities.	2.60	Agree

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Climate-induced shocks affect smallholder farmers' creditworthiness, limiting their ability to invest in their farms.	3.40	Agree
Changes in climate affect the nutrient content of crops, impacting human health and nutrition.	3.0	Agree
More intense rainfall led to increased soil erosion, reducing land productivity over time.	3.50	Agree

Source: Field survey, 2026 **Midpoint** = 2.50

The results presented in Table 1 reflect a comprehensive assessment of perceived climate change-related effects, with mean scores indicating a general agreement among respondents regarding the various impacts of climate change on agriculture and rural livelihoods. Responding to increased temperatures and extreme weather (M=3.50), respondents agree that climate change leads to increased temperatures and extreme weather conditions. This finding aligns with research by IPCC (2021), which indicates that rising temperatures are linked to more frequent and intense weather events, impacting agricultural productivity. The mean score of 3.60 suggests strong agreement on the alteration of rainfall patterns and increased soil erosion. Lal et al. (2018) emphasize that changing precipitation patterns can lead to soil degradation, which adversely affects crop yields and soil fertility. A mean score of 3.40 indicates agreement that warmer temperatures increase pest prevalence. Bebber et al. (2013) found that climate change can expand the range and lifecycle of pests, posing significant risks to both crops and livestock. With a mean score of 3.20, respondents acknowledge that changes in rainfall and evaporation contribute to water scarcity for irrigation. This result corroborates the findings of Mastrorillo et al. (2016), which highlight that water scarcity is a critical issue for agricultural sustainability in many regions affected by climate change. The mean score of 3.50 reflects agreement that climate change alters growing seasons, as noted by Schlenker and Roberts (2009), who found that shifts in climatic conditions can significantly affect planting and harvest timings. The mean score of 3.40 indicates consensus on the damaging effects of increased droughts, floods, and storms on agriculture. Fischer et al. (2012) state that these extreme events not only damage crops but also disrupt food supply chains. A mean score of 3.10 suggests agreement on heat stress affecting livestock health. Thornton et al. (2010) discuss how climate change exacerbates heat stress in livestock, reducing productivity. With a mean score of 3.00, respondents agree that reduced crop yields lead to food shortages and higher prices, corroborated by FAO (2018), which reports that climate change threatens food security globally. A mean score of 3.40 indicates that climate-related disruptions hinder transportation and market access, impacting farmers' incomes. This is supported by Kumar et al. (2021), who found that infrastructure damage from climate events significantly affects market accessibility. The lower mean score of 2.95 reflects agreement on threats to local biodiversity, which is essential for crop resilience. Gallai et al. (2009) emphasize the importance of biodiversity for sustainable agricultural practices. The mean score of 2.90 indicates recognition of the gendered impacts of climate change on smallholder farmers, particularly women, as highlighted by Agarwal (2010), who notes that women face disproportionate challenges in adapting to climate change. The mean score of 2.60 suggests awareness of migration due to deteriorating conditions. This is supported by Black et al. (2011), who discuss how environmental changes can lead to displacement and community instability. A mean score of 3.40 shows agreement that climate-induced shocks impact farmers' creditworthiness, limiting investments in agriculture as noted by Mastrorillo et al. (2016). The

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mean score of 3.00 indicates agreement on changes in nutrient content due to climate impacts, supported by research from Myers et al. (2014), which found that elevated CO2 levels can reduce the nutritional quality of staple crops. A mean score of 3.50 recorded in Table 1 reflects consensus on increased soil erosion from intense rainfall, corroborated by Pimentel et al. (1995), who detail how erosion reduces land productivity over time. These findings corroborate the results of the focus group discussion (FGD, 2026). Specifically, the discussants noted that in a recent focus group discussion, participants expressed strong consensus regarding the impacts of climate change on agriculture and rural livelihoods. They highlighted that increased temperatures and extreme weather events, along with altered rainfall patterns, are significantly affecting crop yields and soil health. Many participants noted the rising prevalence of pests and diseases, which they attributed to warmer conditions. Concerns about water scarcity for irrigation were prevalent, alongside discussions about the economic repercussions of reduced crop yields leading to food shortages and higher prices. The discussants also acknowledged the gendered impacts of climate change, particularly on women farmers, as well as challenges related to livestock health and market access. Participants recognized that these environmental changes could drive migration and disrupt communities, ultimately affecting creditworthiness and the nutritional quality of food.

Table 2: Challenges faced by smallholder farmers in mitigating climate change

Challenges faced by smallholder farmers in mitigating climate change	Mean	Remarks
Many smallholder farmers lack access to timely and accurate weather forecasts and climate data, hindering their ability to make informed decisions.	3.50	Agree
Inadequate rural infrastructure, such as roads and storage facilities, limits farmers' ability to transport goods and access markets.	3.40	Agree
Limited access to credit and financial services makes it difficult for smallholder farmers to invest in climate-resilient practices and technologies.	3.60	Agree
Limited governmental policies and support for climate adaptation hinder smallholders' ability to implement necessary changes.	3.60	Agree
Poor market access limits farmers' ability to sell their produce at fair prices, affecting their income and ability to invest in adaptation measures.	3.50	Agree
Warmer temperatures have led to increased pest populations and the spread of diseases, threatening crop health.	3.40	Agree
Lack of education and training on sustainable agricultural practices hampers farmers' ability to adapt to climate change.	3.60	Agree
Many smallholders rely on rainfed agriculture, making them vulnerable to erratic rainfall patterns and droughts.	3.40	Agree
Women farmers often face additional barriers, such as limited access to resources and decision-making power, which can hinder effective climate action.	3.50	Agree
Insecure land tenure has discouraged investment in long-term sustainable agricultural practices, as most smallholder farmers fear	3.60	Agree

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losing their land.

Source: Field survey, 2026 Midpoint = 2.50

The results presented in Table 2 illustrate the multifaceted challenges that smallholder farmers encounter in their efforts to mitigate climate change. Table 2 revealed a mean score of 3.50 which indicates that many smallholder farmers struggle with a lack of timely and accurate weather forecasts. This finding aligns with the work of Mastrorillo et al. (2016) who emphasize that access to reliable climate information is crucial for effective agricultural decision-making, particularly in regions vulnerable to climate variability. Responding to infrastructure deficiencies, a mean score of 3.40 was recorded which reflects inadequate rural infrastructure, which limits market access and transportation capabilities. This observation is supported by the research of Binswanger-Mkhize and Savastano (2009), who argue that poor infrastructure significantly hampers smallholder productivity and market integration. The mean score of 3.60 for limited access to credit underscores a significant barrier for farmers wishing to invest in climate-resilient practices. According to Ouma et al. (2019), financial constraints are a primary obstacle preventing smallholders from adopting innovative agricultural technologies that could enhance resilience to climate change. Responding to government support, Table 2 revealed a mean score of 3.60, which implies lack of governmental policies for climate adaptation. As noted by Adger et al. (2003), effective government support is essential for enabling smallholder farmers to adapt to climate change through policy frameworks that encourage sustainable agricultural practices. Responding on market access, a mean score of 3.50 indicates that poor market access affects farmers' incomes and their ability to invest in adaptation measures. This finding is corroborated by the work of Barrett (2008), who highlights that improved market access is vital for enhancing the economic resilience of smallholder farmers. The mean score of 3.40 suggests that warmer temperatures have exacerbated pest populations and disease spread, threatening crop health. This aligns with the findings of Lobell et al. (2011), who report that climate change increases the prevalence of pests and diseases, posing significant risks to food security. Responding to education and training gaps, a mean score of 3.60 was recorded which indicates inadequate education and training on sustainable practices. This is consistent with findings from Klerkx and Leeuwis (2009), who stress the importance of knowledge transfer and capacity building in promoting sustainable agricultural practices among smallholders. Table 2 further revealed dependence on rainfed agriculture by smallholder farmers in the study area. The mean score of 3.40 highlights the vulnerability of smallholder farmers reliant on rainfed agriculture amid erratic rainfall patterns. According to Rockström et al. (2009), such dependence increases risks associated with climate variability and necessitates the adoption of more resilient agricultural practices. Responding on gender inequality, a mean score of 3.50 was recorded which reflects the additional barriers faced by women farmers, which is supported by the findings of Quisumbing et al. (2014). Their research indicates that gender disparities in resource access and decision-making significantly hinder women's contributions to climate action. Furthermore, Table 2 revealed a mean score of 3.60 indicates concerns about insecure land tenure discouraging investments in sustainable practices. This is echoed by Deininger et al. (2011), who argue that secure land rights are fundamental for encouraging long-term investments in agriculture.

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Table 3: The adaptation strategies employed to mitigate the impacts of climate change on rural livelihoods,

Adaptation strategies employed by the smallholder farmers	Mean	Remarks
Planting a mix of traditional and climate-resilient crops to reduce vulnerability to climate-related risks, such as drought or flooding.	3.70	Agree
Utilizing improved or genetically modified crop varieties that are resistant to pests, diseases, and extreme weather conditions, such as drought or flooding.	3.50	Agree
Modifying planting schedules based on seasonal weather patterns and forecasts to optimize growth conditions and minimize losses.	3.40	Agree
Implementing practices such as organic fertilization, crop rotation, and cover cropping to enhance soil fertility and structure, improving crop yields.	3.50	Agree
Adopting IPM practices that combine biological, cultural, and chemical methods to manage pest populations sustainably without harming the environment.	3.30	Agree
Employing efficient irrigation methods, such as drip irrigation or rainwater harvesting, to ensure crops receive adequate water during dry periods.	3.40	Agree
Using organic or synthetic mulches to retain soil moisture, suppress weeds, and regulate soil temperature can improve crop resilience.	3.60	Agree
Implementing agroecological principles that promote biodiversity and ecological balance, such as intercropping and polyculture systems.	3.10	Agree
Applying compost, manure, or biochar to improve soil health and enhance the resilience of crops against climate stresses.	3.50	Agree
Rotating different crops in a specific sequence to break pest cycles, improve soil health, and increase overall productivity.	3.50	Agree

Source: Field survey, 2026 Midpoint = 2.50

The results presented in Table 3 highlight various adaptation strategies employed by smallholder farmers, with mean scores indicating a general agreement on the effectiveness of these practices in mitigating climate-related risks. Planting a mix of traditional and climate-resilient crops recorded a mean score of 3.70, which implies that by combining traditional varieties with climate-resilient crops, farmers can better withstand extreme weather events. Research by Altieri et al. (2015) supports this finding, emphasizing that crop diversity is essential for sustainable food systems and resilience to climate change. Utilizing improved or genetically modified crop varieties recorded a mean score of 3.50. This implies that the use of genetically modified organisms (GMOs) enhances yield stability under adverse conditions. This result corroborates the findings of Brookes and Barfoot (2018), who found that genetically modified (GM) crops can significantly reduce losses from pests and diseases, thereby contributing to food security amid climate variability. Adjusting planting dates based on weather patterns recorded a mean score of 3.40. This result aligns with findings by Lobell et al. (2014), who noted that optimizing planting times can improve crop performance and reduce losses, especially in regions with pronounced climate variability. Table 4 further revealed that practices such as organic fertilization and crop rotation recorded a mean score of 3.50, which implies that such practises not only enhance soil fertility but also improve resilience against climate stresses. A study by Tilman et al. (2011) indicates that sustainable practices are vital for maintaining productivity while minimizing environmental impact. Adopting integrated pest management (IPM) practices (Mean: 3.30), employing efficient irrigation methods (Mean: 3.40), using organic or synthetic mulches (Mean: 3.60), implementing agroecological principles (Mean: 3.10), applying compost and organic amendments (Mean: 3.50), while crop rotation recorded a mean score of 3.50.

Table 4: Effectiveness of existing governmental and non-governmental support mechanisms aimed at assisting smallholder farmers in adapting to climate change

Government/nongovernmental support mechanism	Mean	Remarks
Governments at all levels have implemented effective programs that promote climate-smart agricultural practices, which include techniques that increase productivity while reducing greenhouse gas emissions and enhancing resilience to climate change.	2.20	Disagree
Governments often provide effective financial support in the form of subsidies for purchasing drought-resistant seeds, irrigation systems, and other technologies that help farmers adapt to changing climatic conditions.	2.00	Disagree
Agricultural research institutions in your area often work effectively with governments to provide extension services that educate farmers about climate adaptation strategies, sustainable practices, and the use of climate-resilient crops	2.6	Agree
Non-governmental organizations in your area frequently conduct effective training programs to educate smallholder farmers on sustainable agricultural practices, water management, and soil conservation techniques that can help them adapt to climate change.	2.10	Disagree
NGOs in your area have offered effective microfinance services specifically tailored for smallholder farmers, providing them with access to credit for investing in climate-resilient farming technologies and practices.	1.90	Disagree
NGOs in your area have implemented effective community-based adaptation projects that empower local farmers to develop their own strategies for coping with climate change impacts, often through participatory approaches that involve the entire community in decision-making	1.90	Disagree

Source: Field Survey, 2026 Midpoint: 2.50

Results from Table 4 revealed the effectiveness of existing governmental and non-governmental support mechanisms aimed at assisting smallholder farmers in adapting to climate change. Table 4 showed that all the support mechanisms were not effective, except in the area of agricultural research institutions, which often work effectively with governments to provide extension services that educate farmers about climate adaptation strategies, sustainable practices, and the use of climate-resilient crops (M=2.60). These findings corroborate the FGD report, where most of the group expressed disagreement with the effectiveness of government programs aimed at

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promoting climate-smart agricultural practices. Participants felt that while such programs exist, they are not adequately implemented or accessible to farmers in their area. Furthermore, there was a consensus that financial support, such as subsidies for drought-resistant seeds and irrigation systems, is lacking. Participants noted that many farmers struggle to access these resources, which limits their ability to adapt to changing climatic conditions. Responding to collaboration between research institutions and governments, participants agreed that agricultural research institutions collaborate effectively with governments to provide extension services. These services help educate farmers about climate adaptation strategies and sustainable practices, which are seen as valuable resources. The group disagreed regarding the frequency and effectiveness of NGO training programs aimed at educating smallholder farmers on sustainable practices. Many felt that these programs are not widespread enough or do not meet the specific needs of the farmers. Similarly, during the focus group discussion, participants expressed strong disagreement about the availability of microfinance services tailored for smallholder farmers. The lack of accessible credit options was highlighted as a significant barrier to investing in climate-resilient technologies. There was a shared sentiment of disagreement during the FGD regarding the implementation of community-based adaptation projects by NGOs. Participants felt that there is insufficient empowerment for local smallholder farmers to develop their own strategies for coping with climate impacts (FGD, 2026).

4. CONCLUSION AND RECOMMENDATIONS

The study highlights the profound effects of climate change on rural livelihoods, particularly for smallholder farmers in Rivers State, Nigeria. The findings indicate that these farmers are grappling with significant challenges stemming from altered rainfall patterns, increased temperatures, and extreme weather events, all of which threaten their agricultural productivity and economic stability. In response to these challenges, smallholder farmers have implemented various adaptation strategies, such as diversifying crop varieties and adopting sustainable agricultural practices. However, the research also underscores a critical gap in the support mechanisms provided by governmental and non-governmental organizations, which are essential for enhancing the resilience of these vulnerable communities.

Based on the findings of this study, the following recommendations are considered important;

i. Establishment of Comprehensive Support Mechanisms: Government and non-governmental organizations should collaborate to create and implement functional support mechanisms tailored to the needs of smallholder farmers. This could include financial assistance, access to climate-resilient seeds, training programs on sustainable agricultural practices, and improved irrigation systems.

ii. Training programs should be developed to equip extension workers with the necessary knowledge and skills to educate farmers about innovative practices, resource management, and climate-smart agriculture.

iii. Encouraging community participation in developing and implementing adaptation strategies can enhance local ownership and effectiveness. Local governments and organizations should facilitate workshops and forums where farmers can share experiences, discuss challenges, and collaboratively devise solutions.

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