Adapting to Rising Temperatures: Climate Change or Economic Forces? Insights from Northern Nigeria's Tropics

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Abstract

Northern Nigeria's tropical savannah regions face the pressures of rising temperatures and economic instability, profoundly affecting livelihoods and daily life. This study examines whether household adaptation strategies are primarily influenced by direct climate impacts or economic pressures. Using structured questionnaires, 57 households across three geopolitical zones were surveyed to explore specific adaptation strategies and the perceived impact of climate and economic impacts. Results from statistical analyses indicate a significant relationship between climate-driven pressures—such as irregular rainfall and extreme heat—and adaptive behaviors, including income diversification and the adoption of new technologies. Conversely, economic-driven pressures alone did not show a statistically significant association with adaptation choices, suggesting that economic factors become critical primarily when combined with climatic stresses. The findings highlight the interconnected nature of climate and economic vulnerabilities, emphasizing that sustainable policy interventions must integrate climate resilience efforts with economic empowerment initiatives to effectively support adaptive capacities in developing regions.

Keywords: climate change adaptation, rising temperatures, tropical savannah, economic forces, household strategies

Introduction

In recent decades, Northern Nigeria has emerged as a stark microcosm of the challenges a warming planet poses. Rising temperatures have pushed ecological boundaries, disrupted traditional agricultural practices, and reshaped livelihoods in communities heavily dependent on the environment. The convergence of climate change and socio-economic vulnerability within the region paints a complex picture of resilience and adaptation. The region's rapid urbanization has further deepened these vulnerabilities, as population growth and inadequate infrastructure hinder its capacity to adapt to the stresses of climate change. Like many developing areas, the communities in this region face a dual crisis: the immediate impacts of climate-driven heatwaves, erratic rainfall, dwindling resources, and broader, systemic economic challenges that aggravate their susceptibility to environmental stressors. O'Brien & Leichenko (2000) describe this phenomenon in their "double exposure" framework, highlighting how the interplay of environmental and economic forces amplifies vulnerabilities, creating double losers who struggle to adapt to concurrent climate and economic pressures.

Simultaneous pressures from climate change and economic globalization can also drive resilience through innovative adaptive processes. For households, this could mean responses like adopting sustainable agricultural practices, diversifying livelihoods, or leveraging new technologies. Diversification of income sources reduces dependency on single sectors like agriculture, buffering against both economic volatility and climatic shocks. In Nigeria, the overlapping vulnerabilities brought by the double exposure have begun to spur solutions that simultaneously address environmental and economic concerns. Households are beginning to

diversify their income streams, engaging in informal labor markets or small-scale trade to survive as inflation continues to erode purchasing power (World Food Programme 2024). Dynamics like these provide a nuanced backdrop for understanding household adaptations in Northern Nigeria. In this paper, we determine whether such adaptations we have observed stem primarily from climatic pressures, economic forces, or their intersection. By examining how households leverage resilience within this dual-exposure framework, the study contributes to broader discussions on local coping mechanisms in the face of increasing temperatures.

Understanding the relationship between climate change and economic instability is critical for designing effective resilience strategies in vulnerable regions. Besides flood and drought, temperature increase ranked third among the hazards impacting African countries, with Northern Nigeria among the regions facing the impacts of reduced precipitation (State of the Climate in Africa 2023). The rise in temperatures has resulted in significant disruptions to agriculture, resource availability, and overall living conditions. However, attributing household adaptations to only climate change ignores the deep economic forces shaping local responses. Northern Nigeria is representative of many developing regions across the continent also experiencing double exposure. By distinguishing between adaptations driven by climatic impacts and those shaped by economic pressures, this study addresses a gap often observed in climate change adaptation literature.

To achieve the goal of this paper, our objectives are to: (i) identify household coping strategies adopted in response to rising temperatures and a challenging economy; (ii) statistically test the relationship between these strategies and their drivers to see the predominant forces; and (iii) determine statistically the driver of adaptive responses observed among observed households. Our foremost proposition from the findings is that targeted interventions must consider not only climate resilience but also economic empowerment, to ensure local communities receive realistic support. This is a more sustainable way to foster climate change adaptation and improve the quality of life in Northern Nigerian communities and by extension, African regions where the burden of climate change is being disproportionately felt.

Method and Data

The northern regions of Nigeria, characterized by a predominantly tropical savannah climate, face distinct wet and dry seasons and increasing vulnerability to rising temperatures. Agriculture, particularly the cultivation of crops like millet, sorghum, and maize, forms the backbone of the region’s economy. However, factors such as conflict, displacement, limited government support, and high population density further impair the region's climate vulnerabilities. The intersection of climate change impacts and economic instability makes this region an ideal setting to examine how households adapt to the dual pressures of environmental and economic stressors. This context provides a clear foundation for our study, as it explores the adaptation strategies employed by households to navigate these challenges.

Our analysis here draws on data gathered from structured questionnaire responses administered to 61 participants in Northern Nigeria, with valid responses obtained from 57 households. The respondents were sampled from multiple communities across three geopolitical zones, reflecting diverse climatic and socio-economic contexts within Nigeria’s northern tropical savannah region. We employed a mixed-method approach using structured quantitative questions complemented by open-ended qualitative inquiries (QUEST-QUAL format). This approach enabled respondents to provide detailed, self-reported insights on their experiences,

perceptions, and adaptation strategies related to rising temperatures and economic conditions. The quantitative analysis involved exploratory statistics and Fisher's exact tests to explore relationships between identified adaptation strategies and both climate-driven and economic-driven impacts. Qualitative data from open-ended responses were coded thematically to identify deeper narratives, clarify observed quantitative patterns, and highlight localized nuances.

Results

The characteristics of the study sample provide context for understanding how various households respond to pressure. As shown in Table 1, most participants (66.7%) were aged between 26-35 years, with fewer participants in older age groups. Most participants (47.4%) were from medium-sized households (4-6), followed by small households (1-3) representing 35.1%, and large households (7+) comprising 17.5%. Only a small proportion of participants reported being unemployed (5.3%), with the majority (70.2%) engaged in formal employment.

Table 1. Characteristics of participants

Category		N	%
Age group	18-25	7	12.3
	26-35	38	66.7
	36-45	10	17.5
	46-60	2	3.5
Household size	Small (1-3)	20	35.1
	Medium (4-6)	27	47.4
	Large (7+)	10	17.5
Primary income source	Formal Employment (e.g. government or private sector jobs)	40	70.2
	Informal Employment (e.g. casual labor, unregistered businesses)	8	14.0
	Trade/Commerce	4	7.0
	Other	2	3.5
	Unemployed	3	5.3

To distinguish clearly between climate-driven and economic-driven pressures, we categorized participants' responses from the survey as follows:

a) Climate-driven pressure: Household responses that reference direct climatic stressors such as rising temperatures, unpredictable rainfall, drought, or environmental degradation. Examples of adaptations to these include adopting energy-efficient appliances or implementing passive cooling designs specifically mentioned as responses to heat stress.
b) Economic-driven pressure: Strains such as inflation, unemployment, rising cost of living, or market instability, with little or no direct mention of climate impacts. Adaptation to these includes strategies like diversifying income through informal markets, migration to urban areas for better economic opportunities, or reliance on cooperative groups for financial stability.

A third category we observed but are not emphasizing in this paper is double exposure because measuring it is thematically outside the scope of the study. We observed that most participants in the survey were experiencing double exposure in their households, though at varying levels of impact as shown in Figure 1. In our research, double exposure applies to scenarios where households reported motivations arising simultaneously from both climatic pressures and

economic conditions, for example, a participant indicating livelihood diversification (an adaptation strategy) due to reduced agricultural productivity (a climate-driven pressure) and rising cost of living (an economic-driven pressure).

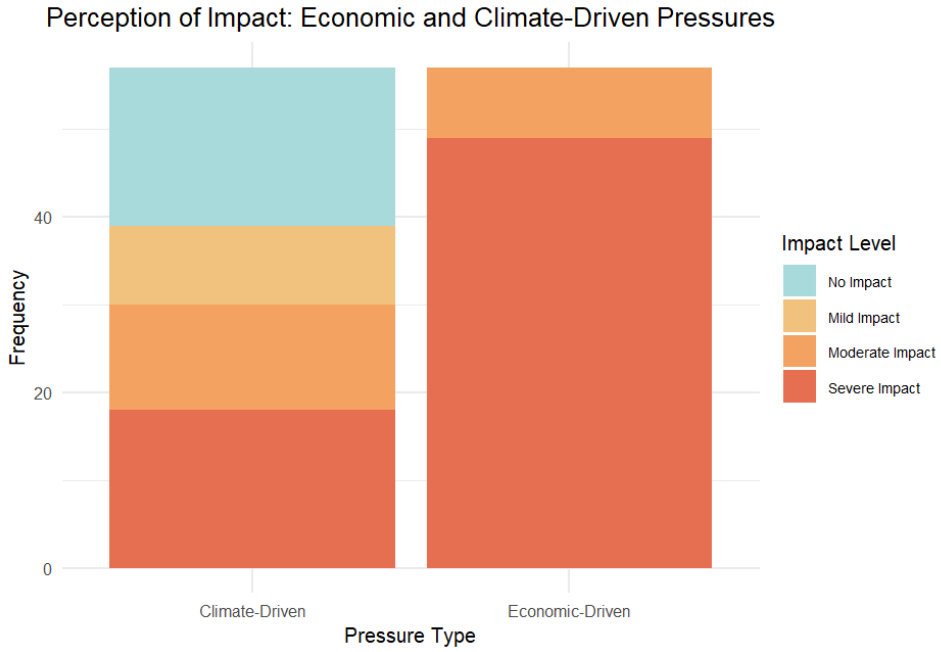

Figure 1. Perception of the impact of economic-driven and climate-driven pressures

The independent variables (economic and climatic) were recoded into categories suitable for statistical analysis by grouping them into an ordinal scale ranked 0 (no impact) to 3 (severe impact). Categories were assigned based on explicit criteria derived from participant responses, where 0 indicated responses like "none," "nothing,", and "not really", and 3 represented comments like "low crop yield" and "decline in productivity." This recoding allowed clear differentiation between varying degrees of impact, allowing us to better understand the relationships being studied.

The responses to climate-driven pressure indicate that most households perceive the climatic changes as moderate to little impact. In ascending order of severity, consider the spectrum of responses to the question we asked, *"How have changes in temperature and rainfall affected your livelihood?":*

a) It has not affected me in any way.
b) Not bad. I'm used to it already.
c) It has affected my livelihood… it has helped me regulate when and how I eat.
d) It has impacted the cost of transportation due to the deteriorating roads.
e) Changes in temperature and rainfall… disrupted agriculture… increased flooding.

These findings align with the fact that while temperature increases, droughts, and flooding are ongoing concerns in the region, households may not always directly link these to long-term livelihood disruptions, suggesting either adaptation or resilience to climate events. The responses support the hypothesis that climate impacts, although significant, may not be uniformly felt across the entire region, with some households possibly engaging in adaptive practices that mitigate these effects.

In contrast, the responses to economic-driven pressure show more participants reporting severe impacts and fewer reporting moderate impacts. By recoding responses like "difficulty accessing credit" and "rising cost of goods" to an ordinal scale, we found that economic pressures are perceived as far more threatening than climatic pressures. From studies of other climate change adaptation literature, we understand that patterns like these are an invitation to further explore the factors that moderate the relationship between economic and climate-driven impacts and adaptation strategies.

Given the limited sample size of households surveyed for the study, we ran two Fisher's exact tests to determine if there is a statistically significant relationship between:

1. Household adaptation strategies and climate-driven pressures.
2. Household adaptation strategies and economic-driven pressures.

$H1_o$: Household adaptation strategies are independent of climate-driven pressures.

The Fisher's test conducted to determine the association between household adaptation strategies and reported climate-driven pressures revealed a statistically significant relationship ($p = 0.0404$), suggesting that the type and severity of adaptation strategies chosen by households are closely linked to their perceived severity of climate impacts. This result, illustrated in Figure 2, indicates that households experiencing more severe climate-related disruptions, such as reduced agricultural productivity or increased flooding, were more likely to adopt specific adaptation strategies, including diversifying income sources, migrating, or adopting climate-smart practices. Therefore, we reject the null hypothesis since climate-driven factors have emerged as strong determinants influencing how households respond to environmental challenges in Northern Nigeria.

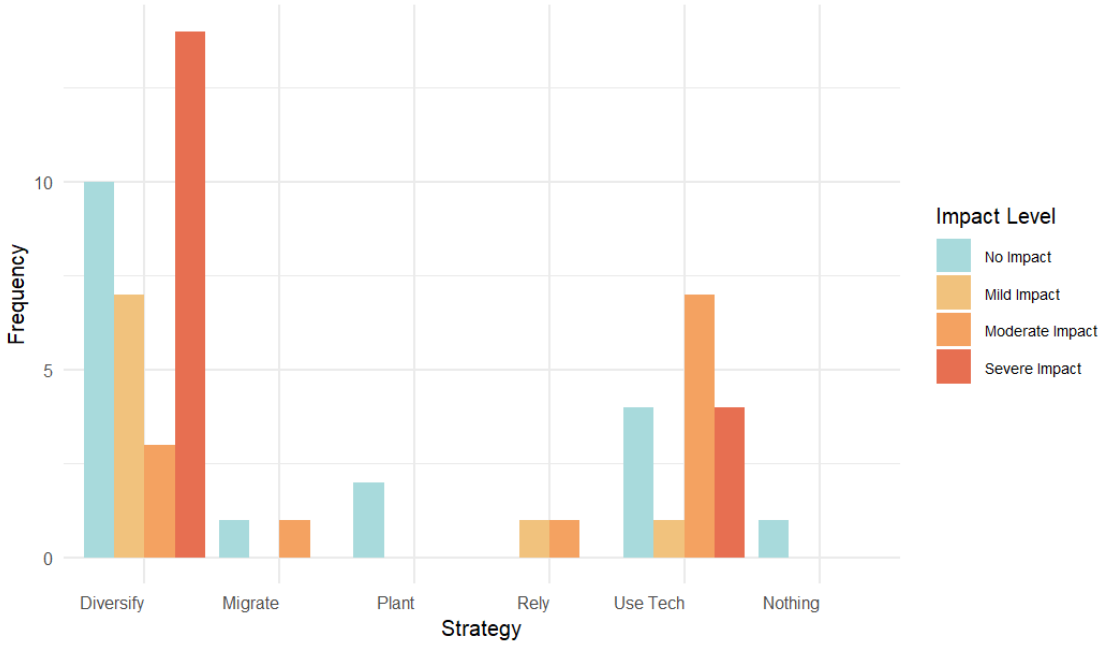

Figure 2. Climate-driven adaptation strategies

"Diversify" (primarily adopting multiple income-generating activities like starting small businesses or taking on additional jobs) stands out among the climate-driven strategies. This suggests that a significant number of households are diversifying their income sources to

cushion losses in other areas, like agricultural productivity due to less or extreme rainfall and extreme temperatures. “Use Tech”, denoting the implementation of new technologies like solar lamps, inverters, and irrigation systems shows a predominantly moderate impact. This interest in leveraging technology to adapt to climate conditions is likely the result of limited access in especially rural areas to steady infrastructure support like electricity. The generally higher frequency of severe and moderate impact in strategies like “diversify” and “use tech” suggests the need for institutional mechanisms to help households better cope with these challenges.

$H2_o$: Household adaptation strategies are independent of economic-driven pressures.

A separate Fisher’s test was conducted to assess the relationship between household adaptation strategies and economic-driven pressures. This revealed a non-significant result ($p = 0.5836$), indicating no strong evidence that economic pressures alone significantly influenced the adaptation strategies adopted by households in the sample. This result was unexpected, given that economic factors such as rising costs and unemployment were prevalent concerns among participants. We fail to reject the null hypothesis here ($p > 0.05$). A possible interpretation for this outcome is that economic pressures, although critical in shaping general household decisions, may not independently drive specific adaptive strategies unless accompanied by direct climatic impacts. Figure 3 shows that like the climate-driven plot, “diversify” and “use tech” remain dominant strategies in the face of severe economic stressors. This suggests the active push for multiple income sources within the region to reduce reliance on a single sector.

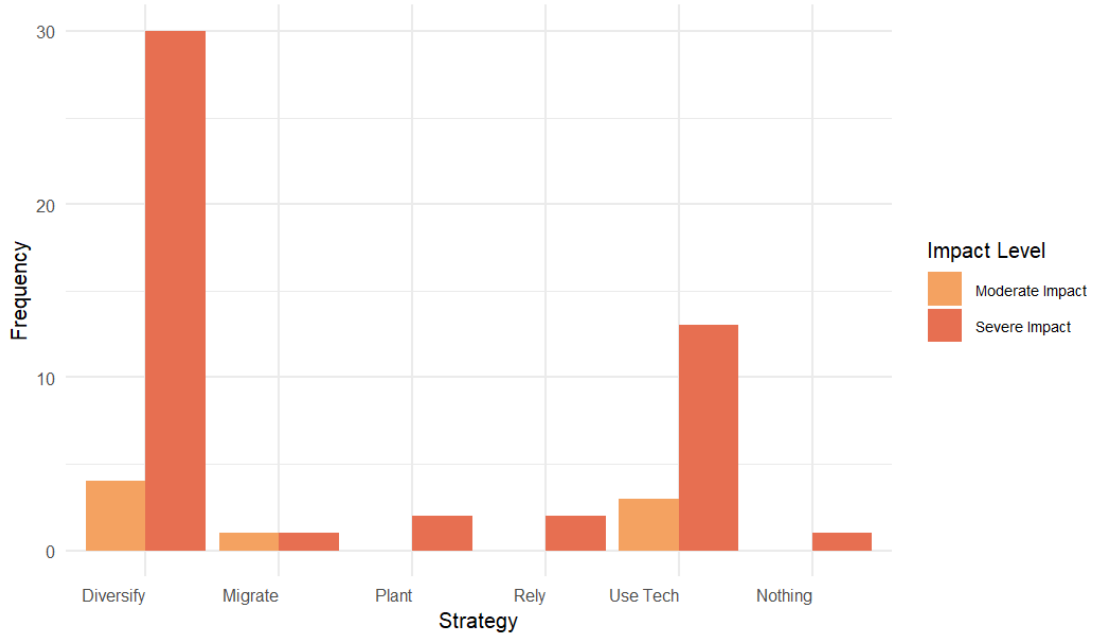

Figure 3. Economic-driven adaptation strategies

Overall, the tests conducted on both climate-driven and economic-driven challenges underline the role of diversification and sustainable technological innovation in adapting to multiple types of stressors. These findings suggest that the interplay between climate and economic-related factors is complex. Most households show resilience to both forces by exploring diversification and adopting new technologies geared toward increased productivity.

Discussion and Conclusion

The findings of this study emphasize the complexity faced by households adapting to environmental and economic pressures in Northern Nigeria. Our analysis reveals that household adaptation strategies are significantly linked to climate-driven impacts, confirming that households experiencing severe climatic stressors are proactively employing strategies such as income diversification and technological innovation to mitigate these threats. Conversely, economic-driven pressures alone did not significantly shape household adaptation decisions, suggesting that economic concerns like inflation and unemployment, while critical, often require the presence of direct climate-related impacts to trigger targeted adaptive responses. An intriguing finding was the critical role of diversification and technological adoption in enhancing household resilience. The prominence of income diversification as an adaptive strategy across both climate-driven and economic-driven impacts indicates its dual utility as an economic buffer and an environmental adaptation measure. Moreover, the adoption of new technologies, such as solar lamps and energy-efficient appliances, reflects increasing community awareness of sustainable solutions that simultaneously address economic costs and environmental stress.

While our study provides valuable insights into the interplay between climate change adaptation and economic challenges, the relatively small sample size used limits the generalizability of the findings across the northern region of Nigeria. Additionally, the limited significance of purely economic factors, despite respondents consistently citing economic hardships, suggests that some households might view economic stress as persistent yet manageable compared to acute climatic threats, which directly threaten livelihood sustainability. We suggest future studies explore the role of institutions in altering households' choices by either amplifying or reducing the influence of climate and economic pressures. This could offer pathways for enhancing resilience and guiding effective adaptation strategies. Our findings highlight the complex realities faced by households in Northern Nigeria, emphasizing that successful adaptation strategies must integrate economic empowerment with climate resilience. Policies addressing climate vulnerabilities should include targeted economic support, particularly aimed at livelihood diversification and access to affordable sustainable technologies.

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