



CLIMATE CHANGE ADAPTATION STRATEGIES AMONG URBAN HOUSEHOLDS IN KADUNA METROPOLIS, NIGERIA

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ABSTRACT

Purpose: Households in urban communities in the Global South are increasingly vulnerable to climate-related risks such as flooding, extreme heat, and water scarcity. These risks are exacerbated by rapid urbanisation, inadequate infrastructure, and socioeconomic inequalities. This study examined climate change survival strategies adopted by urban households in Kaduna State, Nigeria.

Design/methodology/approach: A cross-sectional survey of 120 households was conducted across selected communities in Kaduna metropolis. Data were collected through structured questionnaires and analysed using descriptive statistics, an Adaptation Strategy Index (ASI), chi-square tests, and logistic regression analysis.

Findings: The results showed that households employ various adaptation strategies including housing modifications, drainage improvements, livelihood diversification, and community-based environmental initiatives. Structural housing adaptation and drainage management ranked highest on the adaptation index. Statistical analysis revealed significant relationships between household income, education level, and adoption of adaptation strategies.

Practical implications: Policy interventions should prioritize climate-resilient urban planning, improved drainage systems, and community-based adaptation programs.

Originality/value: The study reveals that while urban households demonstrate resilience through local adaptation practices, institutional support and improved infrastructure are essential for strengthening long-term urban climate resilience.

Keywords: Climate change, urban resilience, adaptation strategies, household vulnerability, Kaduna State.

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1.0 INTRODUCTION

One of the most pressing environmental challenges confronting urban households worldwide is the multifaceted impact of climate change. Rising global temperatures over recent decades have significantly altered precipitation patterns, increased the frequency and intensity of extreme weather events, and heightened environmental risks to human populations (Intergovernmental Panel on Climate Change, 2022). Consequently, urban populations are disproportionately affected by climate-related disasters, including floods, droughts, heat waves, and storms. These impacts are particularly acute in developing countries, where institutional capacity and infrastructural systems are often inadequate to withstand or absorb such environmental shocks (United Nations Human Settlements Programme, 2020). As urban populations continue to expand rapidly, the vulnerability of cities to climate threats has emerged as a critical global development concern. Rapid urbanisation, population growth, and lagging infrastructure development have significantly intensified the impacts of climate change across sub-Saharan Africa. With a current population of about 1.25 to 1.30 billion people (2025–2026 estimates), it is projected to rise rapidly, reaching approximately 2.1 billion by 2050 due to high fertility and youthful demographics (United Nations Department of Economic and Social Affairs, 2019). However, investment in housing, urban infrastructure, and environmental management systems has failed to keep pace with this rapid growth. As a result, many African cities are characterised by widespread informal settlements, inefficient waste management, inadequate drainage systems, and limited access to basic services such as clean water and sanitation (UN-Habitat, 2022; World Bank, 2023).

These structural deficiencies have heightened the exposure and vulnerability of urban populations to climate-related hazards, including heat stress, flooding, and water scarcity (Revi et al., 2014). In particular, according to Adelekan (2016) and Moser (2010), residents of low-income neighbourhoods face heightened sensitivity to climate shocks due to substandard housing, high population density, and restricted access to essential environmental services. Over the past two decades, climate-related environmental challenges have become increasingly prevalent in Nigeria's urban centres. Rapid urban expansion, coupled with poor land-use planning and inadequate environmental infrastructure, has significantly heightened exposure to climatic hazards. According to Ajibade, McBean, and Bezner-Kerr (2014), flooding remains one of the most recurrent natural disasters affecting Nigerian cities, causing severe damage to livelihoods, housing, and transportation infrastructure. Major urban centres, including Lagos, Ibadan, Kano, and Kaduna, have been repeatedly impacted by seasonal flooding, which often triggers population displacement and disrupts economic activities. Urban households often employ a diverse array of adaptation strategies to cope with climate-related risks in response to prevailing environmental stressors. Adaptation strategies are defined as adjustments in human systems that moderate the adverse effects of climate change or enhance resilience to environmental hazards (Satterthwaite & Mitlin, 2023).

At the household level, such measures frequently include structural modifications to housing aimed at reducing flood damage, such as elevating building foundations, constructing drainage channels, and reinforcing walls. Additional strategies encompass the diversification of income sources, environmental management practices, including tree planting and improved waste disposal, and participation in community-based initiatives designed to mitigate local environmental risks (Pelling, 2011). These bottom-up, locally driven adaptation strategies play a critical role in enhancing resilience, particularly in contexts where formal institutional support for climate adaptation remains limited. Although the impacts of climate change in Nigeria are increasingly acknowledged, there remains a significant gap in empirical data on how urban households can effectively mitigate these effects (Gyang, 2023). In particular, there is limited understanding of the dynamics of household adaptation in rapidly growing northern urban centres. This is largely because most existing studies have focused on rural agricultural adaptation or climate vulnerability in coastal cities (Zitta,

Akinseye, & Mwanja, 2015). Understanding how urban households perceive climate hazards and the coping strategies they adopt is essential for designing effective climate policies and building urban resilience. Such insights can enable policymakers to develop targeted interventions that strengthen infrastructure, improve urban environmental management, and support community-based adaptation strategies.

According to the Federal Ministry of Environment, Department of Climate Change (2021), the National Climate Change Policy for Nigeria 2021–2030 envisions “a low-carbon, climate-resilient Nigeria.” Its mission is to ensure sustainable development and a climate-proofed economy through multi-stakeholder engagement. Strategic objectives include implementing adaptation and mitigation measures for low-carbon growth, strengthening capacities at local, state, and national levels, promoting scientific research, technology, and innovation, reducing vulnerability across sectors, mainstreaming gender, children, youth, and vulnerable groups, and enhancing resource mobilisation. The policy tries to promote a low-carbon, climate-resilient society through integrated mitigation and adaptation measures aligned with the Nationally Determined Contribution (NDC) and the Climate Change Act 2021. In Kaduna, seasonal flooding (as shown in Plate I), rising temperatures, and chronic drainage problems have emerged as persistent environmental concerns, particularly during the peak rainy season. In many residential areas, flood risk has been exacerbated by inadequate drainage systems, unregulated urban sprawl, and the blockage of natural water channels (Adelekan, 2016). These environmental challenges not only threaten physical infrastructure but also undermine the socioeconomic stability of vulnerable urban households.



Plate I: Flooding in Kaduna State

Source: <https://www.google.com/search?q>

In light of the foregoing, this study examines the climate change adaptation strategies employed by urban households in Sabon Tasha, Barnawa, Mahuta, and Romi, Kaduna State, Nigeria, as shown in Figure I below. By analysing the coping mechanisms adopted by households in response to climate-related environmental challenges, the study seeks to contribute to the growing body of literature on urban climate adaptation in developing countries. It further aims to provide policy-relevant insights for enhancing climate resilience in Nigerian cities. Specifically, the study investigates the adaptation strategies of urban households in Kaduna State and offers strategic recommendations for mitigating the impacts of climate change in urban centres.

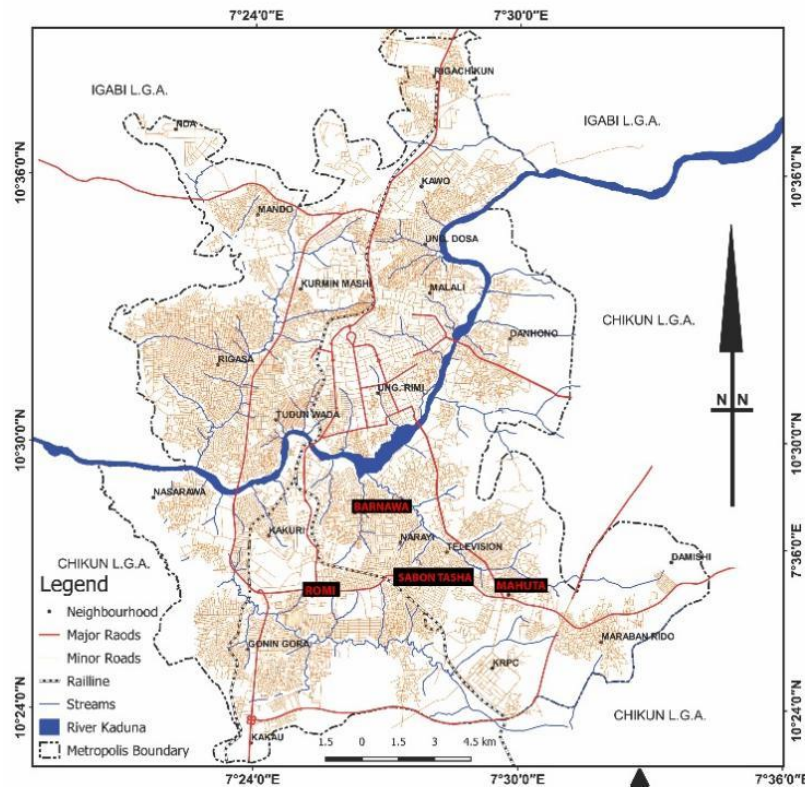


Figure I: Kaduna metropolis showing the study area

2.0 LITERATURE REVIEW

2.1 Urban Climate Vulnerability

Urban climate vulnerability denotes the degree to which urban populations and systems are exposed to climate-related hazards and their capacity to anticipate, cope with, resist, and recover from the adverse effects of environmental change. Vulnerability is widely conceptualised as a function of three interrelated components: exposure, sensitivity, and adaptive capacity (Intergovernmental Panel on Climate Change, 2014).

- Exposure refers to the extent to which urban populations and infrastructure are physically subjected to climate hazards, such as floods, heat waves, droughts, and storms.
- Sensitivity describes the degree to which these hazards affect social, economic, and environmental systems.
- Adaptive capacity reflects the resources, capabilities, and processes available to individuals, households, communities, and institutions to adjust to climate risks and reduce potential harm (World Bank, 2023).

Collectively, these components shape the overall vulnerability of urban systems to climate change.

Urban areas are increasingly recognised as a critical location of climate vulnerability. By concentrating large populations, economic activities, and critical infrastructure within relatively confined geographic spaces, cities amplify the potential impact of climate hazards. Consequently, such hazards can precipitate widespread disruption to housing, transportation networks, public health systems, and economic functions. According to the IPCC, urban settlements worldwide are confronted with escalating climate risks associated with rising temperatures, more intense precipitation events, and sea-level rise, particularly in coastal cities (Revi et al., 2014). These risks are further compounded by rapid urbanisation, which frequently results in unplanned urban expansion and heightened pressure on environmental resources. Urban populations in developing countries are

particularly vulnerable to the impacts of climate change due to entrenched structural socioeconomic and infrastructural constraints. Many cities across Africa, Asia, and Latin America are characterised by inadequate infrastructure, widespread informal settlements, weak land-use planning, and limited institutional capacity. These conditions collectively undermine the ability of urban systems to effectively manage and respond to environmental risks (World Bank, 2023)

Informal settlements, in particular, are frequently situated in environmentally hazardous locations, such as floodplains, steep slopes, and poorly drained wetlands. Residents of these communities often lack access to essential services, including functional drainage systems, solid waste management, potable water supply, and reliable electricity. Consequently, they face heightened exposure and susceptibility to a range of climate-related hazards (Moser, 2010). Furthermore, limited institutional capacity in many developing countries significantly constrains the ability of governments to formulate and implement effective climate adaptation and disaster risk reduction strategies. Weak urban planning regulations, inadequate financial resources, and fragmented governance structures frequently impede proactive responses to climate-related risks (Pelling, 2011). Consequently, urban residents, particularly low-income households, are often compelled to depend on informal coping mechanisms and community-based strategies to address climate-induced environmental challenges. A nuanced understanding of these dynamics is therefore critical for designing policies that enhance urban resilience and promote sustainable adaptation to climate change.

2.2 Household Adaptation Strategies

Adaptation strategies refer to adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which serve to moderate harm or exploit beneficial opportunities (IPCC, 2014). Such strategies encompass actions undertaken by individuals, households, communities, and institutions to reduce vulnerability and enhance resilience to environmental hazards. Adaptation is especially critical in developing countries, where the impacts of climate change are often severe and institutional capacity for large-scale interventions is limited (Gyang, 2023). At the household level, adaptation strategies are often shaped by the level of information and resources available to them (Gyang, 2023). Households frequently adopt a range of practical measures to minimise the impacts of climate-related hazards on their livelihoods, housing, and well-being, which is better than doing nothing at all. One common adaptation approach involves structural housing modifications, such as elevating building foundations, reinforcing walls, installing protective barriers, or improving roofing systems to withstand heavy rainfall and flooding. These structural adjustments help reduce the physical damage caused by climate hazards and improve the resilience of residential buildings (Pelling, 2011).

Furthermore, many households have diversified their sources of livelihood as a result of climate variability, which often disrupts traditional income-generating activities, particularly in communities that rely heavily on climate-sensitive sectors such as agriculture or informal trading. To reduce economic vulnerability, households may diversify their income sources by engaging in multiple livelihood activities, including small-scale businesses, wage employment, and informal-sector work. Such diversification provides financial stability and helps households recover more quickly from climate-related shocks (IPCC, 2022). Community environmental initiatives also play an essential role in local climate adaptation. In many urban communities, residents organise collective actions such as sanitation campaigns, drainage clearing, tree planting, and waste management activities to reduce environmental risks. These initiatives strengthen social capital and promote shared responsibility for managing environmental challenges at the neighbourhood level (Moser & Satterthwaite, 2008).

In addition, water management practices represent another critical adaptation strategy in many climate-vulnerable communities. Households may adopt measures such as rainwater harvesting, water storage systems, improved drainage channels, and water conservation practices to cope with

both flooding and water scarcity. These strategies help households manage changing rainfall patterns and ensure more reliable access to water resources (Adger et al., 2003).



Plate II: Kaduna State Government official clearing drainage

Source: <https://www.premiumtimesng.com/>

Household-level adaptation plays a crucial role in strengthening climate resilience, particularly in contexts where government intervention (Plate II), infrastructure provision, and formal adaptation programs remain limited. In many developing countries, local communities often serve as the first line of defence against climate risks, relying on indigenous knowledge, social networks, and locally developed coping strategies to manage environmental uncertainties (United Nations Human Settlements Programme, 2020). Consequently, understanding household adaptation practices is essential for designing policies that support community-based resilience and enhance sustainable urban climate adaptation.

3.0 CONCEPTUAL FRAMEWORKS

The conceptual framework for this study is based on the Vulnerability Adaptation Framework, which was developed by Karney and Bradbury in 1995. This framework explains how enduring vulnerabilities, external stressors, and adaptive processes interact to influence the quality and stability of relationships over time. It emphasises the dynamic responses to stress within intimate partnerships. Additionally, the framework suggests that household adaptation strategies are affected by various socio-economic and environmental factors.

3.1 Socioeconomic Characteristics, Adaptive Capacity, Adaptation Strategies

Socioeconomic characteristics such as income, education, and livelihood assets play a critical role in shaping households' adaptive capacity, thereby influencing their ability to anticipate, respond to, and recover from environmental stresses. A robust adaptive capacity facilitates the adoption of effective adaptation strategies, such as livelihood diversification, technological adoption, and institutional engagement. Consequently, this enhances resilience to both climate variability and long-term environmental change across diverse global contexts (Adger, 2003; Smit & Wandel, 2006).

4.0 METHODOLOGY

The study employed a cross-sectional survey design. It was conducted in Kaduna metropolis, located in Northwestern Nigeria. Kaduna is a rapidly expanding urban centre that is experiencing increasing environmental pressure resulting from population growth and urban expansion. The study population comprised urban households residing in selected communities within the Kaduna metropolis. A multistage sampling technique was utilized. In the first stage, four communities, Sabon Tasha, Barnawa, Mahuta, and Romi, were selected based on their exposure to climate hazards. In the second

stage, households were randomly selected from within these communities. A total sample of 120 households was surveyed. Primary data were collected using structured questionnaires administered to household heads.

To measure household adaptation capacity, an Adaptation Strategy Index (ASI) was developed. The Adaptation Strategy Index (ASI) was computed using the Weighted Mean (Average Weighted Score) to rank the adaptation strategies adopted by households.

The index is calculated as:

$$ASI = \sum W_i X_i / \sum X_i \dots\dots\dots \text{eqn I}$$

Where:

W_i = weight assigned to adaptation strategy

X_i = frequency of adoption

Strategies with higher Adaptation Strategy Index (ASI) values correspond to more commonly adopted adaptation practices. Primary and secondary data were collected using quantitative and qualitative methods. Descriptive statistics, specifically frequencies, percentages, and mean ranking, were employed, while inferential statistics, including the chi-square test and logistic regression analysis, were applied. The least square regression model is expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \dots\dots\dots \text{eqn II}$$

Where:

Y = adoption of adaptation strategy

X_1 = income

X_2 = education

X_3 = household size

ε = white noise

A total of 120 urban households were surveyed across selected communities in Kaduna metropolis. The socio-economic characteristics of the respondents are presented using frequencies and percentages.

5.0 RESULTS AND DISCUSSION

The table below shows the socio-economic characteristics of respondents:

Table 1: Socio-economic characteristics of respondents (n = 120)

Variable	Category	Frequency	Percentage (%)
Gender	Male	72	60
	Female	48	40
Age	18–30	28	23
	31–45	52	43
	46–60	30	25
Education	No formal education	18	15
	Primary education	26	21
	Secondary education	44	36
	Tertiary education	32	27
Monthly income	₦50,000–₦100,000	40	33
	Above ₦100,000	34	28
Household size	1–4	36	30
	5–8	58	48
	Above 8	26	21

The results in Table 1 indicated that male respondents comprised 60% of the sample, while female respondents accounted for the remaining 40%. The largest proportion of respondents (43%) fell within the 31–45 age brackets, suggesting that economically active adults predominate in urban households within the study area. With respect to educational attainment, the highest percentage (36%) was recorded for secondary education, implying a moderate level of literacy among residents. Regarding monthly household income, 38% of households reported earnings between ₦50,000 and ₦100,000, reflecting a moderate economic capacity that may influence decisions related to adaptation strategies. This aligns with Adger et al. (2003), who noted that socioeconomic characteristics such as income, education, and livelihood assets play a critical role in shaping households' adaptive capacity.

5.1 Climate Change Adaptation Strategies Adopted by Households

Households reported adopting a range of strategies to cope with climate-related environmental risks, including flooding and extreme rainfall. The frequency and percentage distribution of these coping strategies are presented in Table 2.

Table 2: Household adaptation strategies

Adaptation Strategy	Frequency	Percentage (%)
Raising building foundations	78	65
Clearing drainage channels	92	77
Diversifying livelihood activities	70	58
Tree planting	54	45
Improved waste disposal	66	55
Rainwater harvesting	48	40

The findings indicated in Table 2 that the most commonly adopted structural adaptation measures among households were the clearing of drainage channels (77%) and the raising of building foundations (65%). These strategies were primarily aimed at mitigating the impacts of flooding, a recurrent environmental challenge in several parts of the Kaduna metropolis. These structural adjustments helped reduce the physical damage caused by climate hazards and improved the resilience of residential buildings (Pelling, 2011).

5.2 Adaptation Strategy Index (ASI) and Mean Ranking

To determine the relative importance of different adaptation strategies, a mean ranking analysis using the Adaptation Strategy Index (ASI) was conducted.

Table 3: Mean ranking of adaptation strategies

Adaptation Strategy	Mean Score	Rank
Drainage cleaning	3.62	1st
Raising building foundations	3.48	2nd
Improved waste disposal	3.12	3rd
Livelihood diversification	2.96	4th
Tree planting	2.64	5th
Rainwater harvesting	2.31	6th

The results in Table 3 showed that drainage clearing ranked first ($M = 3.62$), followed by raising building foundations ($M = 3.48$), while improved waste disposal ranked third. These findings suggested that households prioritised structural and environmental management measures to reduce climate-related risks, particularly flooding. This finding corroborated Gyang (2023), who affirmed that participation in climate action in any form was far more important than doing nothing at all.

5.3 Chi-Square Analysis of Socio-Economic Factors and Adaptation

A chi-square test that examined the relationship between selected socio-economic variables and the adoption of climate change adaptation strategies is presented in Table 4 below.

Table 4: Chi-square relationship between household characteristics and adaptation

Variable	χ^2 value	df	p-value	Decision
Education level	12.84	3	0.005	Significant
Household income	10.62	2	0.014	Significant
Household size	4.12	2	0.128	Not significant

Chi-square test results in Table 4 reveal a statistically significant association between education level ($p = 0.005$) and household income ($p = 0.014$) and the adoption of climate change adaptation strategies. This finding suggests that households with higher educational attainment and greater income levels are more likely to implement effective adaptation measures. This aligns with Adger et al. (2003), who noted that socioeconomic characteristics such as income, education, and livelihood assets play a critical role in shaping households' adaptive capacity.

5.4 Logistic Regression Analysis of Determinants of Adaptation

A binary logistic regression model was used to determine the key socio-economic factors influencing the adoption of climate adaptation strategies among urban households as shown in Table 5.

Table 5: Logistic regression results

Variable	Coefficient (β)	Std. Error	Odds Ratio	p-value
Education	0.62	0.21	1.86	0.003
Income	0.54	0.19	1.71	0.006
Household size	0.18	0.14	1.20	0.210
Occupation	0.31	0.17	1.36	0.072

The regression results demonstrated that both education and income exert a statistically significant influence on household adaptation behaviour. Education yields a positive coefficient ($\beta = 0.62$), suggesting that higher educational attainment is associated with an increased likelihood of adopting climate adaptation strategies. Likewise, income exhibits a positive relationship ($\beta = 0.54$), indicating that households with greater financial stability possess an enhanced capacity to invest in structural and environmental adaptation measures. However, household size and occupation were not statistically significant predictors at the 5% level, although they showed positive relationships with adaptation behaviour. Adger et al. (2003) expressed a similar view, affirming that socioeconomic characteristics such as income, education, and livelihood assets play a critical role in shaping households' adaptive capacity.

5.5 Discussion of Findings

The findings of this study highlight the importance of household-level adaptation practices in responding to climate risks in urban areas. Structural measures such as drainage clearing and housing modifications were the most commonly adopted strategies, reflecting the high exposure of households to flooding in Kaduna metropolis.

The statistical results further demonstrate that education and income significantly influence adaptation capacity, supporting previous studies which argue that socio-economic resources enhance the ability of households to implement effective climate adaptation measures (Adger, 2006; Smit & Wandel, 2006).

These findings suggest that improving public awareness, environmental education, and household income opportunities could significantly enhance climate resilience in urban communities.

6.0 CONCLUSION

The study examined climate change adaptation strategies among urban households in Kaduna State and made the following conclusion:

- a. Households employ various strategies, including drainage construction, housing modifications, and livelihood diversification.
- b. Socioeconomic factors such as income and education significantly influence adaptation capacity.
- c. Strengthening urban climate resilience requires integrated policy interventions that combine community initiatives with improved infrastructure and institutional support.

7.0 POLICY RECOMMENDATIONS

1. Nigeria's Climate Change Policy (2021–2030) should prioritise directly empowering local communities to drive climate adaptation efforts. This participatory approach would align with the Nationally Determined Contribution (NDC) targets and the Climate Change Act 2021. By supporting community-led initiatives, building local resilience, and integrating indigenous knowledge, Nigeria can enhance adaptive capacity, reduce vulnerability, and ensure inclusive, grassroots-driven progress toward national climate goals.
2. The Kaduna State Government must empower the Ministry of Lands, Survey Kaduna State Urban Planning Development Authority, and Kaduna State Geographical Information System to urgently revise and upgrade the Kaduna City Development Plan. This revision should prioritise the proper construction, routine maintenance, and regular clearing of drainage systems and climate-smart buildings across the metropolis, thereby preventing persistent flooding, safeguarding lives and property, and ensuring sustainable urban resilience.
3. Nigeria's Climate Change Policy (2021–2030) and the Kaduna State Ministry of Environment should design and implement an effective, inclusive campaign programme that communicates climate actions at the grassroots level, tailored to diverse household realities. Using local languages, traditional media, and community networks, the initiative will enhance understanding, promote sustainable practices, and drive nationwide participation.

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