

STRATEGIES TO CLIMATE CHANGE ADAPTATION IN NIGERIA: EFFECTIVENESS AND BARRIERS AMONG RURAL HOUSEHOLDS IN WARRI SOUTHWEST, NIGERIA

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ABSTRACT

Climate change is eroding the natural resource base in Warri Southwest, Nigeria, where rising temperatures, recurrent flooding, and shifting rainfall patterns undermine fisheries, agriculture, and food security. This study examines the socio-demographic characteristics of rural households and evaluates the effectiveness and barriers of their adaptation strategies. Using a multistage sampling design across four climate-vulnerable communities, 240 valid household responses were collected through surveys and complemented by focus group discussions. Descriptive analysis was employed to assess adaptation practices, constraints, and perceived effectiveness. Findings reveal that households are predominantly young, economically active, and engaged in diverse livelihoods such as farming, fishing, and trading. Adaptation strategies widely adopted include livelihood diversification, relocation of fishing activities, and flood-control measures. While these approaches provide short-term coping benefits, adaptive capacity is constrained by financial exclusion, limited access to credit, weak extension services, inadequate infrastructure, and low education levels. Vulnerability in Warri Southwest is therefore shaped less by knowledge deficits than by structural and institutional barriers. Strengthening resilience requires integrated institutional, community-based, and technological interventions. Recommendations include expanding access to credit, enhancing climate education, strengthening extension services, investing in resilient infrastructure, and embedding adaptation into local development planning. These findings underscore the need for comprehensive policy frameworks to support rural households in transitioning from incremental coping strategies to sustainable, transformative adaptation pathways.

Keywords: Climate change adaptation; Rural households; Niger Delta; Adaptive capacity; Livelihood diversification; Institutional barriers

1. INTRODUCTION

Climate change has become one of the defining development challenges of the twenty-first century, particularly in low- and middle-income countries where climatic shocks intersect with poverty, weak infrastructure, and dependence on climate-sensitive livelihoods. In Nigeria, the Niger Delta is among the most vulnerable regions due to its low-lying coastal topography, dense river networks, and exposure to flooding, erosion, and sea-level rise. These climatic pressures are compounded by oil exploration, gas flaring, and wetland degradation, creating a complex risk landscape where environmental degradation and climate variability reinforce each other (Udie, Bhattacharyya, & Ozawa-Meida, 2018; Ebelegi, 2025; Michael et al., 2026; Agumagu, Marchant, & Stringer, 2026).

Existing studies in Delta State highlight flooding (Kadafa, 2012; Ite, Ibok, Ite & Petters, 2013), rainfall variability (Ebhuoma & Simatele, 2017), and declining soil fertility (Abaje, Sawa, Iguisi, & Ibrahim, 2016) as major drivers of food insecurity and livelihood instability. However, findings diverge on whether vulnerability is primarily biophysical (Hassan, Kalin, Aladejana, & White, 2020) or structural (Emaziye, Okoh, & Ike, 2013; Butu, Okeke, & Okereke, 2022; Defrance, Lescure, & Sultan, 2025), pointing to unresolved questions about the role of institutional and socio-economic conditions in shaping adaptation outcomes. While households adopt diverse strategies such as crop diversification (Shakirat, et al., 2022), altered planting calendars (Fasina, Okogbue, Ishola, & Adeeko, 2021), and livelihood diversification, their effectiveness remains contested. Some scholars Rasak et al. (2018) view these practices as evidence of resilience, while others (Opaluwa, Gbenga, & Mercy, 2019; Sedegah, Ajayi, & Adu-Okoree, 2020; Oyebisi et al., 2026) argue they are reactive coping mechanisms constrained by limited credit, weak extension services, and governance gaps.

Despite growing research on climate adaptation in Nigeria, critical gaps persist. Many studies catalogue adaptation practices without systematically evaluating their long-term effectiveness or considering how oil-related environmental degradation interacts with institutional constraints. Moreover, cross-sectoral dynamics linking agriculture, fisheries, water, and health remain underexplored. This study addresses these gaps by assessing adaptation strategies among rural households in Warri Southwest, Delta State, an oil-impacted and climatically vulnerable locality. Specifically, it evaluates the effectiveness of household adaptation measures, identifies structural barriers, and analyzes socio-economic determinants shaping adoption and sustainability, thereby contributing evidence for more integrated and equitable resilience planning in the Niger Delta.

2. MATERIALS AND METHODS

2.1 Study Area Description

Warri Southwest is a local government area situated in Delta State, Nigeria. The region lies between latitudes 5°31'N and 6°11'N and longitudes 5°E and 5°6.4'E, encompassing both coastal and inland zones. It is bordered by the Atlantic Ocean to the south and traversed by rivers, creeks, mangrove swamps, and estuaries, all shaped by the Niger Delta's hydrology and soil composition (Balogun & Onokerhoraye, 2022). Figure 1 shows the location of Warri South West with rural communities studied. The climate is equatorial, with a wet season from April to October and a dry season from November to March, influenced by the moisture-laden south-westerly maritime air mass and the dry north-easterly continental air mass. Mean annual temperatures range between 26–28 °C, while rainfall averages 3,000 mm annually (Adejuwon, 2011, 2012).

Warri South West's population has grown steadily from about 116,500 in 2006 to an estimated 172,800 in 2026 - a nearly 50% increase over two decades, driven by natural growth and migration linked to oil and gas activities. This population pressure intensifies demand for land, fisheries, and other natural resources, thereby increasing household vulnerability to climate change impacts (Ukhurebor et al., 2021). The area's economy is dual in nature: while oil and gas production dominate nationally, local communities rely heavily on fishing, small-scale farming, and trading for subsistence and income (Ikhumetse, Abioye, & Ijah, 2022; Igbani, Tatah, & Odekina, 2024). These livelihoods are highly climate-sensitive, with flooding, salinity intrusion, and rainfall variability directly affecting productivity and household resilience.

The ecological fragility of mangroves, wetlands, and estuaries makes Warri Southwest particularly sensitive to climate stressors. Oil pollution further compounds this sensitivity by degrading ecosystems, reducing fish stocks, and undermining agricultural productivity (Ukhurebor et al., 2021). The region's households face dual stressors: climate variability and oil-related environmental degradation. Understanding adaptation strategies here provides critical insights into how rural communities in resource-rich but ecologically fragile areas can build resilience. Lessons from Warri Southwest are therefore essential for designing policies that integrate climate adaptation with sustainable development in Nigeria's Niger Delta.

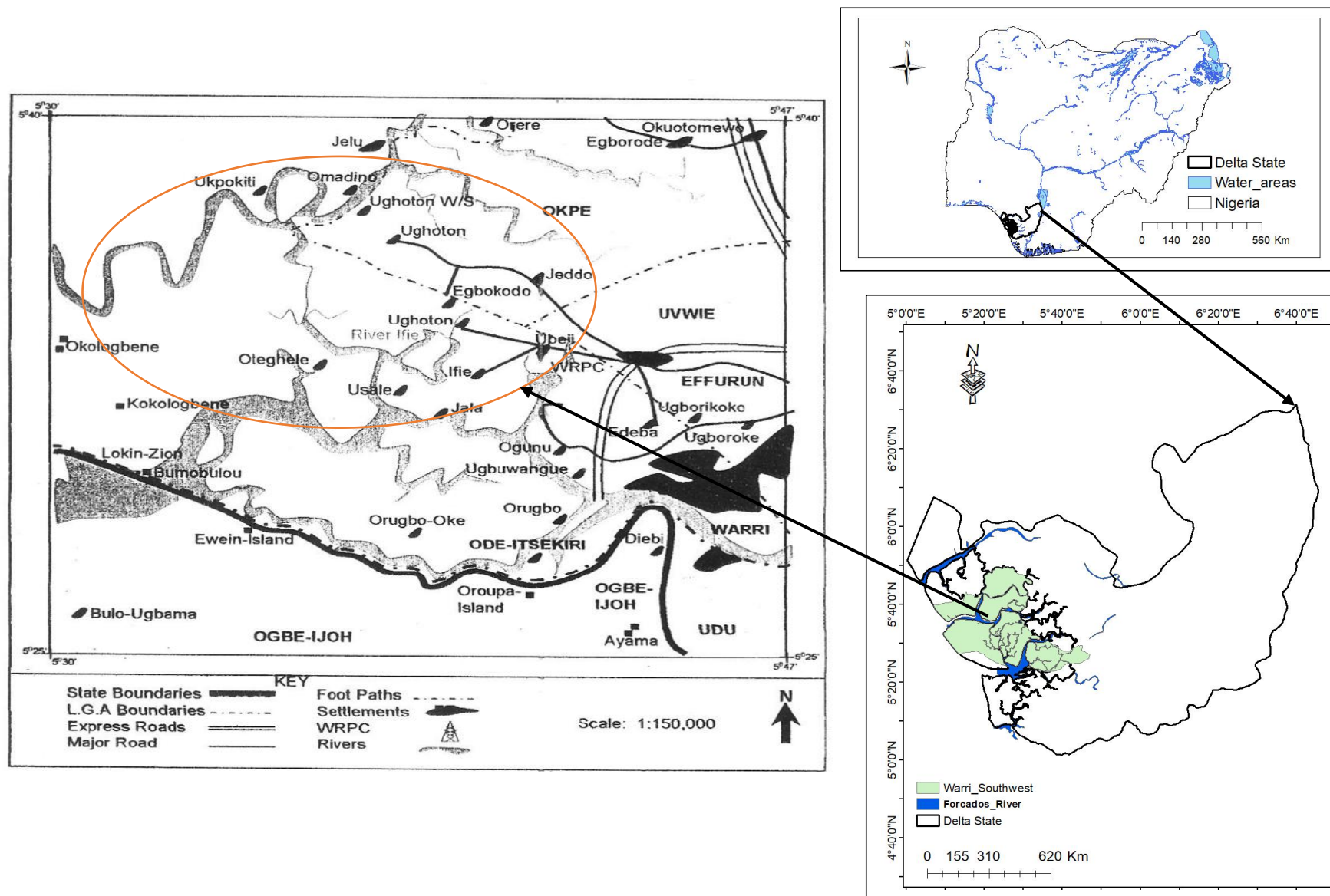


Figure 1: Location of Warri South West with rural communities sampled.

2.2 Data Collection and Analysis

A multistage sampling technique was employed to ensure effective representation of rural households in Warri Southwest. This method was chosen because it balances purposive selection of climate-sensitive communities with systematic random sampling of households, thereby reducing bias and improving representativeness. In the first stage, four communities - Oteghale, Ughoton, Okologbene, and Oporoza were purposively selected due to their exposure to climate risks and livelihood dependence on natural resources. In the second stage, households within each cluster were chosen using systematic random sampling to ensure fairness and coverage. Fisher's formula was applied to determine the minimum sample size, given the population growth beyond the 2006 census figure of 116,681.

A structured questionnaire was administered to 300 household heads. This method was chosen to capture nuanced socioeconomic and adaptation data while minimizing literacy barriers. The questionnaire covered socioeconomic characteristics, awareness of climate change impacts, adaptation strategies, perceived effectiveness, and constraints. Out of 300 questionnaires, 263 were retrieved (87%), but only 240 were duly completed and used for analysis. To complement survey data, focus group discussions (FGDs) were conducted to generate qualitative insights, validate questionnaire items, and capture community perspectives. Descriptive statistics (frequencies, percentages, and mean scores) were used to analyze responses, providing a clear overview of adaptation strategies and barriers. While the methods provide robust insights into adaptation strategies, effectiveness, and barriers, the study is limited by reliance on self-reported data, absence of longitudinal tracking, and focus on four communities, which may not capture the full diversity of Warri Southwest.

3. RESULTS AND DISCUSSION

3.1 Climate Change Awareness and Risk Perception

Table 1 summarizes the impacts and causes of climate change. The survey results indicate that climate change awareness is nearly universal among respondents, with 96.6% reporting knowledge of climate change and 84.2% acknowledging direct impacts. Most households (73.4%) have observed changes for over five years. Rainfall variability (97.9%), flooding (93.8%), and poor yields (94.6%) were identified as the most visible indicators, while heat stress (56.3%) and vector-borne diseases (33.3%) were less frequently recognized. Information is primarily transmitted through informal networks such as friends and relatives (95.8% and 93.3%), with limited reliance on extension agents (22.5%) or formal media.

Table 1: Response to the impacts of climate change and causes

Variables	Frequency	Per cent
Awareness of climate change		
Yes	232	96.6
No	8	3.3
If yes, for how long have you observed this change		
1	3	1.3
2	14	5.8
3	38	15.8
4	9	3.8
≥5	178	73.4

Source of information about climate change		
Friends	230	95.8
Relatives	224	93.3
Radio	161	67.8
Extension Agents	54	22.5
Print media	19	7.9
Television	16	6.7
Internet	12	5.0
Newspaper	1	0.4
How will you rate your knowledge of climate change		
Good	126	52.5
Poor	114	47.5
Evidence of Climate Change		
Late commencement of rainfall	235	97.9
Early cessation of rainfall	230	95.8
Poor yield	227	94.6
Flood	225	93.8
Environmental degradation	217	90.4
Drought	209	87.1
Erosion	204	85.0
Early dryness of small streams	149	62.1
Heavy wind	145	60.4
Heat stress	135	56.3
Have you been affected by climate change		
Yes	202	84.2
No	20	8.3
No Idea	18	7.5
What do you think are the causes of climate change		
Overgrazing	238	99.2
Deforestation	216	90.0
Agricultural activities	212	88.3
Bush burning	68	28.3
Burning of fossil fuels	8	3.3
Burning of household wastes	18	7.5
What are the climate change impacts faced in your community?		
Flooding	145	60.4
Sea Level Rise	233	97.1
Coastal Erosion	149	62.1
High Temperature	135	56.3
Food Scarcity	228	95.0
Spread of Vector-borne Diseases	8	33.3
Drought	67	27.9
Migration	85	35.4
Displacement	0	0.0

Source: Field survey 2023

These findings align with studies in Delta State and other Nigerian regions, where flooding and rainfall variability consistently dominate local climate narratives (Abaje et al., 2016; Okafor, Sadiku, Okhimamhe, & Eichie, 2017). Similar patterns of informal knowledge transmission have been documented in rural contexts, reflecting weak penetration of formal climate governance structures (Butu et al., 2022). However, unlike some regions where drought is prioritized, households in Warri Southwest emphasize hydrological instability, consistent with the deltaic environment's sensitivity to water-related hazards.

Taken together, the results suggest that while awareness of climate change is high, technical understanding remains uneven and shaped by immediate livelihood impacts. Reliance on informal networks for information highlights institutional gaps in climate communication and early warning systems. The prioritization of flooding and rainfall shifts underscores the acute vulnerability of food systems and fisheries to hydrological variability, reinforcing the need for integrated adaptation strategies that address water, food, and livelihood security simultaneously.

3.2 Socio-demographic Structure and Adaptation Strategies

The socio-demographic profile presented in Table 2 reveals that households in Warri Southwest are predominantly young (52.1% aged 25–35), male-headed (76.6%), and economically active, with large family sizes that provide labour for adaptation practices. Education levels remain low, with 58.8% reporting only primary education, and access to credit is severely limited (87.1% excluded). Income distribution indicates that while more than half earn above NGN 100,000 annually, overall investment capacity remains constrained.

Adaptation strategies (Table 3) most widely adopted include livelihood diversification (87.9%), relocation of fishing activities (89.2%), and crop/fish diversification (73.3%). Infrastructural measures such as drainage construction (41.7%) and formal early warning systems (4.2%) are less common, reflecting financial and institutional barriers. Climate change has significantly affected fishing and farming, with households reporting shifts in fish species distribution, declining fish density, and increased travel distances to fishing grounds due to rising water temperatures and salinity. Farmers also adjust planting and harvesting dates to cope with flooding and rainfall variability. Focus group discussions highlighted risks such as the capsizing of fishing boats due to excessive waves. Soil and water conservation practices were also reported as strategies to counter land degradation from flooding and erosion. Finally, households reported increasing pest and disease pressures, with many adopting chemical fertilisers, manure, pesticides, and vaccinations to mitigate the impacts. Only a small fraction (2.9%) reported not using any adaptation method.

Table 2: Socio-demographic Characteristics of the Respondents (n=240)

Variables	Frequency	Per cent
Age (years)		
<25	14	5.8
25-35	125	52.1
36-45	71	29.6
45-55	29	12.1
>55	1	0.4
Sex		
Male	184	76.6
Female	56	23.3
Marital status		
Married	167	69.6
Single	14	5.8
Divorced	26	10.8
Widowed	33	13.8
Household size		
<2	7	2.9
2-4	49	20.4
5-7	72	30
8-10	62	25.8
>10	50	20.8
Educational Level		
No formal education	29	12.1
Primary education	141	58.8
Secondary education	38	15.8
Tertiary education	32	13.3
Primary occupation		
Private Sector	73	30.4
Public Sector	24	10
Retired	15	6.3
Self-employed	93	38.8
Unemployed	35	14.6
Average Income Level		
<10,000	47	19.6
10,000-30,000	31	12.9
31,000-50,000	14	5.8
51,000-70,000	3	1.3
70,000-100,000	9	3.8
>100,000	136	56.7
Member of social organisation		
Yes		
No	139	57.9
	101	42.1
Access to credit		
Yes	31	12.9
No	209	87.1

Source: Computed from field data, 2023.

These findings mirror patterns observed in other Nigerian states, where households rely heavily on informal, labour-based adaptation strategies (Solomon & Edet, 2018; Danso-Abbeam, Ojo, Baiyegunhi, & Ogundeji, 2021). Similar dependence on livelihood diversification has been documented in Bayelsa (Muyiwa, Medugu, Ayo, & Modibbo, 2022) and Oyo State (Sedegah et al., 2020). Extension workers confirmed most of these coping strategies, consistent with findings from Enimu & Onome (2018), Etim & Etim (2020), and Muyiwa et al. (2022). However, the magnitude of credit exclusion in Warri Southwest appears particularly severe, underscoring a paradox: proximity to oil wealth does not translate into household adaptive capacity. Studies elsewhere highlight education, income, and cooperative membership as key determinants of adaptation (Opaluwa et al., 2019; Oyebisi et al., 2026), yet the dominance of low education levels here suggests structural limits on scaling more advanced strategies.

Table 3: Climate Change Adaptation Strategies Adopted By Households

Adaptation Strategies	Frequency	Percent (%)
Do you adopt adaptation measures against the effects of climate change in your area?		
Yes	233	97.1
No	7	2.9
If yes, which measures		
Early warning systems	10	4.2
Changing fishing locations	214	89.2
Water conservation practices	30	12.5
Construction of drainage/barrier system	100	41.7
Altering fishing times	85	35.4
Community engagement and education	35	14.6
Intensive fertilizer/manure	100	41.7
Using crop varieties/fish diversification	176	73.3
Livelihood diversification	211	87.9
Using soil conservation techniques	60	25.1
Using different gear/net types	11	4.6
Financial support for coastal flood-affected farmers	7	2.9
Religious beliefs and prayer	46	19.2
Adjusting the timing of farm operations	89	37.1
Skipping storage to processing and marketing immediately after harvest	100	41.7
Migration	5	2.1

Source: computed from field data, 2023.

Taken together, the results indicate that adaptation in Warri Southwest is widespread but largely autonomous, incremental, and resource-constrained. Households rely on flexible, low-cost strategies that buffer immediate risks but do not address long-term resilience. The severe financial exclusion and weak institutional support highlight governance gaps that prevent households from transitioning to transformative adaptation. This reinforces the study's central argument: vulnerability in Warri Southwest is driven less by knowledge deficits than by structural and institutional barriers, making integrated policy interventions essential.

3.3 Dominant Adaptation Strategies: Patterns and Effectiveness

As illustrated in Figure 2, respondents generally rated their adaptation strategies as effective, with 31 households reporting them as “very effective,” 45 as “effective,” and 24 as “not effective.” The most effective practices were those that directly reduced exposure to hazards, such as relocating fishing grounds and diversifying livelihoods. These measures share a common feature: they are flexible, behaviour-based, and require limited institutional input. Infrastructure-based strategies, including drainage construction, were moderately adopted, while migration and formal early warning systems remained minimal. An unexpected finding was the relatively high reliance on religious beliefs and prayer as coping mechanisms, underscoring cultural dimensions of resilience but offering limited physical protection against hazards.

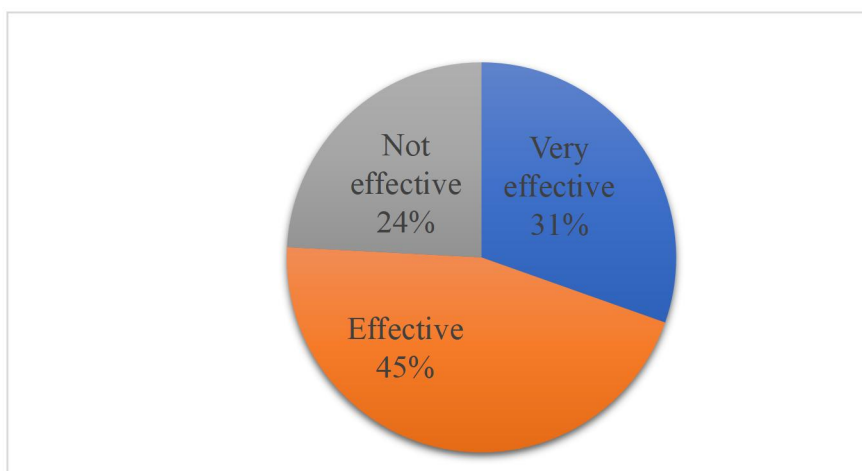


Figure 2: Reported effectiveness of adaptation strategies among rural households in Warri Southwest

These findings are consistent with broader evidence from Africa that smallholder adaptation is often reactive and constrained by resource scarcity (Rasak et al., 2018; Sedegah et al., 2020; Danso-Abbeam et al., 2021). Similar reliance on livelihood diversification has been documented in other Nigerian states, though the prominence of religious coping in Warri Southwest is less frequently emphasized in the literature. Studies elsewhere highlight the limited uptake of water conservation practices and formal early warning systems, underscoring systemic gaps in institutional support (Butu et al., 2022).

The findings suggest that households in Warri Southwest rely heavily on autonomous, behaviour-based strategies that provide short-term relief but do not fully address long-term resilience. The effectiveness of strategies is strongest when they directly reduce exposure, yet reliance on informal and cultural mechanisms indicates limited confidence in formal adaptation systems. From a water-energy-food security perspective, these strategies reveal trade-offs: fishing relocation safeguards protein supply but increases fuel costs. At the same time, livelihood diversification cushions income shocks but may reduce agricultural focus. Overall, adaptation remains locally rational but fragmented, highlighting the need for integrated approaches that balance food, energy, and water security in climate adaptation planning.

3.4 Structural Constraints and Critical Findings

Households in Warri Southwest reported significant barriers to effective adaptation (Figure 3). The most critical constraints include lack of finance (96.7%), labour shortages (94.2%), poor access to credit (87.1%), weak extension services (61.7%), and inadequate infrastructure. Education deficits (52.5%) and limited climate information (61.7%) further restrict adaptive capacity. Respondents also highlighted reliance on informal networks for climate knowledge, such as friends and relatives, with minimal institutional support emphasizing the role of informal communication in rural contexts.

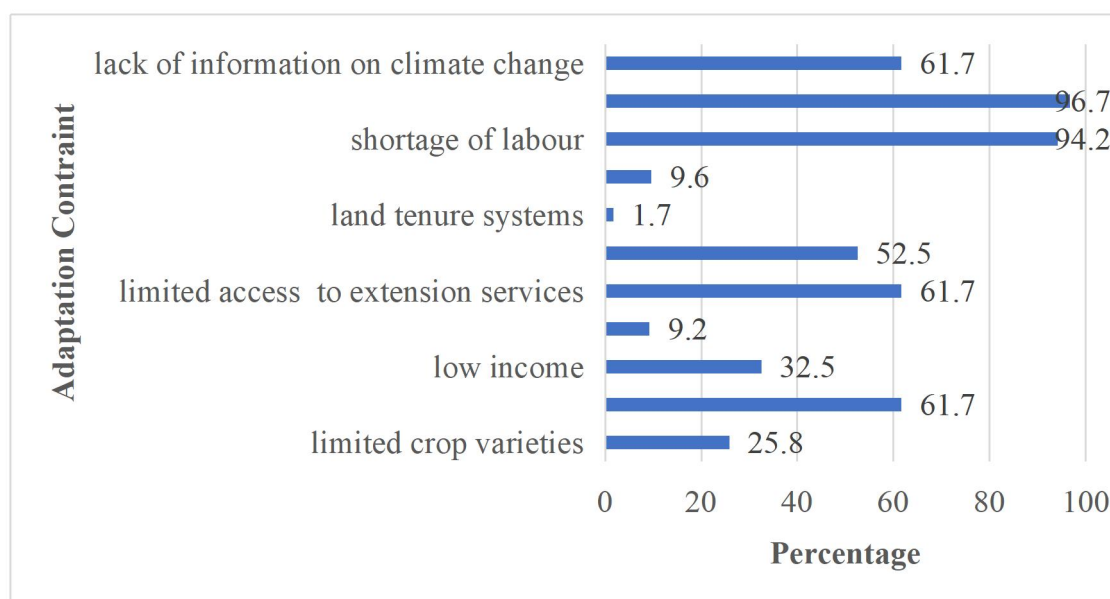


Figure 3: Constraints to climate change adaptation among rural households in Warri Southwest

These results mirror findings from other Nigerian contexts, where institutional gaps and financial exclusion are consistently identified as primary determinants of adaptation limits (Ofuoku, 2011; Ajieh & Okoh, 2012; Ikehi, Onu, Ifeanyieze, & Paradang, 2014; Opaluwa et al., 2019; Butu et al., 2022). Access to weather information and extension services has also been shown to significantly influence adaptation choices (Enimu & Onome, 2018; Etim & Etim, 2020). Low income and restricted credit access play a substantial role in shaping household adaptation strategies. Limited financial resources often force households to rely on less costly, sometimes less effective measures, rather than investing in advanced options such as irrigation systems, resilient crop varieties, or protective infrastructure. Similar patterns of weak extension services and inadequate infrastructure have been documented across sub-Saharan Africa, reinforcing the structural nature of adaptation ceilings. However, the magnitude of financial exclusion in Warri Southwest appears particularly severe, despite the region's proximity to oil wealth. This governance paradox - resource extraction without resilience investment has been noted in Niger Delta scholarship but remains underexplored in household-level adaptation studies.

The findings demonstrate that adaptation in Warri Southwest is constrained less by knowledge deficits than by systemic institutional and financial barriers. Households rely on social capital, livelihood diversification, and cultural coping mechanisms, but these remain reactive and incremental. Weak vertical coordination between meteorological services and

rural communities, coupled with poor integration of adaptation into local development planning, further undermines resilience. The evidence underscores the need for targeted interventions, including expanding credit access, strengthening extension services, and investing in resilient infrastructure, to move households beyond coping towards transformative adaptation pathways.

3.5 Policy and Practical Implications

The findings reveal that rural households in Warri Southwest are highly aware of climate change and actively adopt diverse strategies such as livelihood diversification, fishing relocation, and crop/fish diversification. While these measures provide short-term coping benefits, they remain largely autonomous and resource-constrained. Severe financial exclusion, weak extension services, and inadequate infrastructure prevent households from transitioning to transformative adaptation. This governance paradox - resource wealth without resilience investment underscores the structural nature of vulnerability in the Niger Delta.

Enhancing climate change adaptation requires institutional reforms that strengthen extension services, expand access to credit, and embed adaptation planning into local government frameworks. Financial inclusion is particularly critical, as households consistently identify a lack of credit and income as the most significant barriers. Governance reforms should prioritize integrating climate adaptation into development planning, ensuring that resilience is not left to informal coping mechanisms alone.

At the community level, resilience is currently sustained through social capital and livelihood diversification rather than systemic support. Promoting cooperative societies for resource pooling, expanding climate education, and supporting participatory early warning systems can empower households to respond more effectively. Educational programs are vital, given that low literacy and limited awareness remain major obstacles. As Feinstein and Mach (2019) emphasize, education enhances adaptive learning and capacity-building, enabling households to adopt sustainable practices more confidently.

Technological interventions are equally important. Investment in flood-resilient infrastructure, improved crop and fish varieties, and low-cost water conservation technologies can reduce exposure to hazards. Expanding early warning systems coordinated by NIMET would provide timely information for adjusting fishing locations, planting calendars, and livelihood diversification. Insurance programs tailored to climate-related losses, though currently underutilized, could offer financial protection. Finally, community-based disaster risk reduction (CBDRR) programs and training in climate-resilient enterprises such as sustainable fishing, beekeeping, and small-scale businesses would strengthen adaptive capacity while addressing the water-energy-food security nexus that underpins household vulnerability.

CONCLUSION

This study demonstrates that rural households in Warri Southwest are highly aware of climate change and actively adopt diverse adaptation strategies, yet their efforts remain largely autonomous, incremental, and constrained by systemic barriers. Livelihood diversification and fishing relocation provide immediate coping benefits, but limited access to credit, weak extension services, and inadequate infrastructure prevent households from achieving transformative resilience. By systematically evaluating adaptation practices and their perceived effectiveness, the study clarifies that vulnerability in Warri Southwest is driven less by knowledge deficits than by structural and institutional constraints. The paradox of having

resource wealth but lacking resilience investment highlights the urgent need for integrated approaches that move beyond short-term coping.

RECOMMENDATIONS

The findings contribute to research by highlighting the intersection of household adaptation with the water-energy-food security nexus, while offering practical policy guidance. Strengthening financial inclusion, embedding adaptation into local development planning, investing in resilient infrastructure, and expanding climate education are critical steps toward sustainable resilience. Ultimately, empowering households through institutional support, community initiatives, and technological innovation will enable Warri Southwest to transition from coping to long-term climate adaptation. Overall household adaptation in Warri Southwest remains widespread but constrained, revealing the urgent need for integrated institutional support and community-based innovation. Future research should examine the long-term sustainability of these strategies and conduct comparative studies across Niger Delta communities to understand better how governance and environmental pressures shape resilience pathways.

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