JOURNAL OF OCCUPATIONAL HEALTH, RISK MANAGEMENT AND SAFETY
A journal of Department of Environmental Management, Faculty of Environmental Sciences, University of Calabar, Nigeria
https://johrms-unical.com.ng/

https://doi.org/10.60787/johrms.vol1no2.37 ONLINE ISSN: 3121-8806

Assessment of Indigenous Knowledge and Climate Resilience in River Benue Communities, Nigeria

[1]Idoma, Kim, Department of Geography and Environmental Management, Faculty of Science, Gombe State University, Nigeria, https://orcid.org/0009-0003-8474-8111, Email: kimidoma@gsu.edu.ng
Nafisat, Auwal Mohammed. Department of Geography and Environmental Management, Faculty of Science, Gombe State University, Nigeria, https://orcid.org/0009-0007-4908-5040, Email: nafisatuauwalu@gsu.edu.ng
Jeje, Olasunkanmi Gabriel, Department of Geography, Federal University, Dutsin-Ma, P.M.B.5001, Dutsin-Ma, Katsina State, Nigeria, https://orcid.org/0009-0005-1901-4327, Email: ojeje@fudutsinma.edu.ng
[1]Corresponding author.

Abstract

Rural communities along Nigeria's River Benue face increasing climate variability, erratic rainfall, floods, and droughts that threaten their predominantly agricultural and fishing livelihoods. This study assesses how indigenous knowledge (IK) and traditional practices enhance climate resilience in selected River Benue communities. Using a mixed-methods approach, we conducted 120 household interviews across six villages, complemented by four focus group discussions and secondary literature review. Results show that 78% of farmers rely on natural indicators (such as animal behaviour, plant phenology, wind, and cloud patterns) to predict seasonal weather, which increases planting timeliness by an estimated 24% compared to those who adopt later. About 65% of households practice water harvesting and communal pond storage, while 71% cultivate drought-resistant crops such as millet, sorghum, cassava, and cowpea. Agroforestry and mulching are employed by 59% of respondents, leading to an average 18% increase in soil moisture retention during dry spells. Commons management remains strong: 82% of communities enforce taboos or rotational fishing rules, while fish fences (weirs) on the river contribute up to 35% of seasonal fish catch. Local institutions, particularly village councils and elders, resolve over 70% of reported disputes on land and water access through mediation. Collectively, these IK-based strategies have improved household food security by 22% (measured as months of adequate food provisioning) and reduced income loss from climate shocks by 15% over the past decade. The findings demonstrate that integrating ancestral wisdom with modern adaptation strategies can significantly strengthen resilience, safeguard livelihoods, and promote sustainable development in River Benue communities under a changing climate.

Keywords: Climate, Indigenous, Resilience, Knowledge, River Benue, Communities

How to Cite: Idoma, K, Nafisat, A. M and Jeje , O.G (2026), Assessment of Indigenous Knowledge and Climate Resilience in River Benue Communities, Nigeria, JOHRMS, Volume 1, Issue 2, 64-77

Introduction

Climate change, broadly understood as long-term shifts in temperature, rainfall, and the frequency of extreme weather events, is increasingly linked to both natural variability and human-induced factors such as deforestation and greenhouse gas emissions (IPCC, 2023). In sub-Saharan Africa, these shifts are most visible in changing rainfall patterns, which directly affect agriculture, water availability, and rural livelihoods. Within Nigeria's Middle Belt, particularly the Benue River valley, the signs of climate variability are already evident: rainfall has become increasingly erratic, floods recur with greater intensity, and drought periods are longer than before (Akinyemi & Olayemi, 2022; Mohammed et al., 2023). Such climatic instability presents profound risks, as more than 70 per cent of rural Nigerians depend heavily on rain-fed agriculture and inland fisheries for food and income (FAO, 2022).

Against this backdrop of environmental stress, indigenous knowledge emerges as a critical cultural resource. Indigenous knowledge, or IK, refers to the cumulative body of know-how, practices, and beliefs that evolve through generations and are deeply rooted in local ecological systems (Berkes, 2018). Unlike formal scientific forecasting, this knowledge is experiential and often expressed through culturally specific interpretations of nature. For example, farmers in the Benue valley observe bird migrations, the flowering of trees, shifts in wind direction, and cloud formations as early warning signs of impending seasonal transitions (Ebele & Emodi, 2021). Communities also rely on traditional water harvesting techniques, soil fertility conservation, and collective management of fisheries and forests, which reflect adaptive strategies fine-tuned to the local environment. In this way, indigenous knowledge operates as a mediating factor that helps rural people anticipate, respond to, and recover from climate shocks, thereby contributing to resilience understood here as the capacity of a system to absorb and adapt to disturbance while maintaining its essential functions (Adger et al., 2021).

The central focus of this study, therefore, is to explore the interaction between climate variability and indigenous practices, and how these dynamics shape outcomes such as food security, sustainable resource management, and livelihood stability in River Benue communities. To address this aim, the study identifies and documents local weather forecasting methods and their relevance for farming and fishing; examines traditional systems of water, land, and resource management; analyses how these strategies enhance household resilience to climate stress; and explores the role of community institutions in sustaining such practices.

In framing the scope, attention is restricted to rural communities located along the River Benue, where agriculture and riverine activities dominate everyday life. The analysis is particularly concerned with three thematic domains of indigenous practice: weather prediction, natural resource governance, and conflict resolution over land and water use. Although the emphasis is on present-day strategies, the study also draws upon oral histories and secondary sources to illustrate how these practices have evolved under shifting climatic conditions. Rather than offering a technical comparison between indigenous and scientific systems, the purpose is to highlight complementarities that could inform integrated adaptation approaches.

By situating indigenous knowledge within the broader discourse of climate change adaptation, this study adds to ongoing debates on sustainable rural development, knowledge integration, and community-led resilience. In doing so, it underscores the importance of recognizing ancestral wisdom not as a relic of the past but as a living, dynamic resource that continues to shape how River Benue communities navigate environmental uncertainty (Nakashima et al., 2022; Nyong et al., 2023)

Climate Variability and Livelihood Vulnerability

Climate change and variability remain among the most pressing environmental challenges globally, with particularly severe impacts in sub-Saharan Africa, where livelihoods depend heavily on agriculture, fisheries, and forestry. In Nigeria's Middle Belt and the Benue River basin, erratic rainfall, recurrent floods, and prolonged droughts have intensified food insecurity, ecological degradation, and poverty (Adelekan & Asiyanbi, 2022). Flood episodes displace thousands of households annually (Nkwunonwo et al., 2020), while dry spells deepen water scarcity and reduce yields (Ayanlade &

Radeny, 2020). The region's reliance on rainfed agriculture makes even slight climatic shifts destabilising, underscoring the need for robust adaptive strategies**.**

Indigenous Knowledge as a Resource for Adaptation

Indigenous knowledge (IK) constitutes a cumulative body of observations and practices developed over generations to cope with environmental stressors. Farmers and fishers employ bio-indicators such as bird migration, wind patterns, cloud cover, and tree flowering to forecast weather (Nyong et al., 2022). Unlike scientific forecasting, IK is community-driven, low-cost, and socially legitimate. Agricultural adaptations include crop diversification, agroforestry, mulching, and planting drought-resistant crops such as sorghum, cassava, and cowpea (Mubaya & Mafongoya, 2017). In fisheries, seasonal bans, taboos, and communal fish fences ensure stock regeneration (Olaniyi et al., 2021). Water management strategies such as rainwater harvesting, communal ponds, and regulated water sharing further illustrate how ecological knowledge is tied to social governance (Yaro et al., 2021).

Challenges of Indigenous Knowledge Systems

Despite their relevance, IK systems face significant erosion. Younger generations often perceive them as outdated due to modernization, education, and media exposure (Berkes, 2018). Climate unpredictability has also reduced the reliability of traditional indicators, while state-led adaptation programs frequently sideline local practices in favor of technocratic solutions. This marginalisation limits opportunities for hybrid approaches that integrate both systems.

Theoretical Foundations

Resilience Theory provides a lens for understanding how communities absorb climatic shocks while sustaining core functions (Folke et al., 2016). In the Benue basin, IK contributes to resilience by shaping adaptive responses that maintain food security, biodiversity, and social stability.

The Socio-Ecological Systems (SES) perspective highlights the interdependence of human and ecological systems (Ostrom, 2009). Practices such as agroforestry and fishing taboos serve dual ecological and social roles, demonstrating the inclusiveness of IK within broader environmental systems.

Finally, Knowledge Co-production emphasizes the value of integrating local and scientific knowledge to enhance the credibility and usability of adaptation strategies (Norström et al., 2020). Hybrid solutions such as merging indigenous forecasts with meteorological data or combining local conflict resolution with formal institutions emerge as effective pathways to resilience.

Gaps in the Literature

While the role of IK in adaptation is widely recognized, significant gaps remain. Most studies are descriptive, with limited quantitative evidence on resilience outcomes such as yield stability or food security improvements. Interactions between traditional institutions and formal governance are underexplored, and gendered dimensions, particularly women's role in knowledge transmission, water management, and crop diversity, remain understudied. Addressing these gaps is crucial for designing inclusive, evidence-based resilience strategies in the Benue basin.

Synthesis

The literature demonstrates that indigenous knowledge is both an adaptive asset and a cultural identity marker, sustaining ecological stewardship and social cohesion. However, its declining transmission and marginalization threaten long-term viability. Integrating IK with scientific approaches within resilience and SES frameworks offers a promising pathway for strengthening climate adaptation in River Benue communities. This study therefore contributes to bridging local and global knowledge systems while advancing sustainable rural development

Study Area

The River Benue, Nigeria's second-largest river, originates from the Adamawa Plateau in northern Cameroon and flows westward through Adamawa, Taraba, and Benue States before joining the River Niger at Lokoja, Kogi State (Oladipo & Abaje, 2010). The Benue basin occupies a strategic ecological and socio-economic position within Nigeria's Middle Belt, characterised by diverse ethnic groups, rich agricultural resources, and highly variable climatic conditions (Figure 1). The climate of the basin transitions from sub-humid tropical in the upper reaches to tropical savanna downstream, with marked wet and dry seasons. Rainfall is concentrated between April and October, averaging 1,200–1,600 mm annually, while the dry season is dominated by the Harmattan winds from November to March (Adebayo & Oruonye, 2013). Temperatures range from 21°C to 34°C, reflecting the seasonal contrasts of the region.

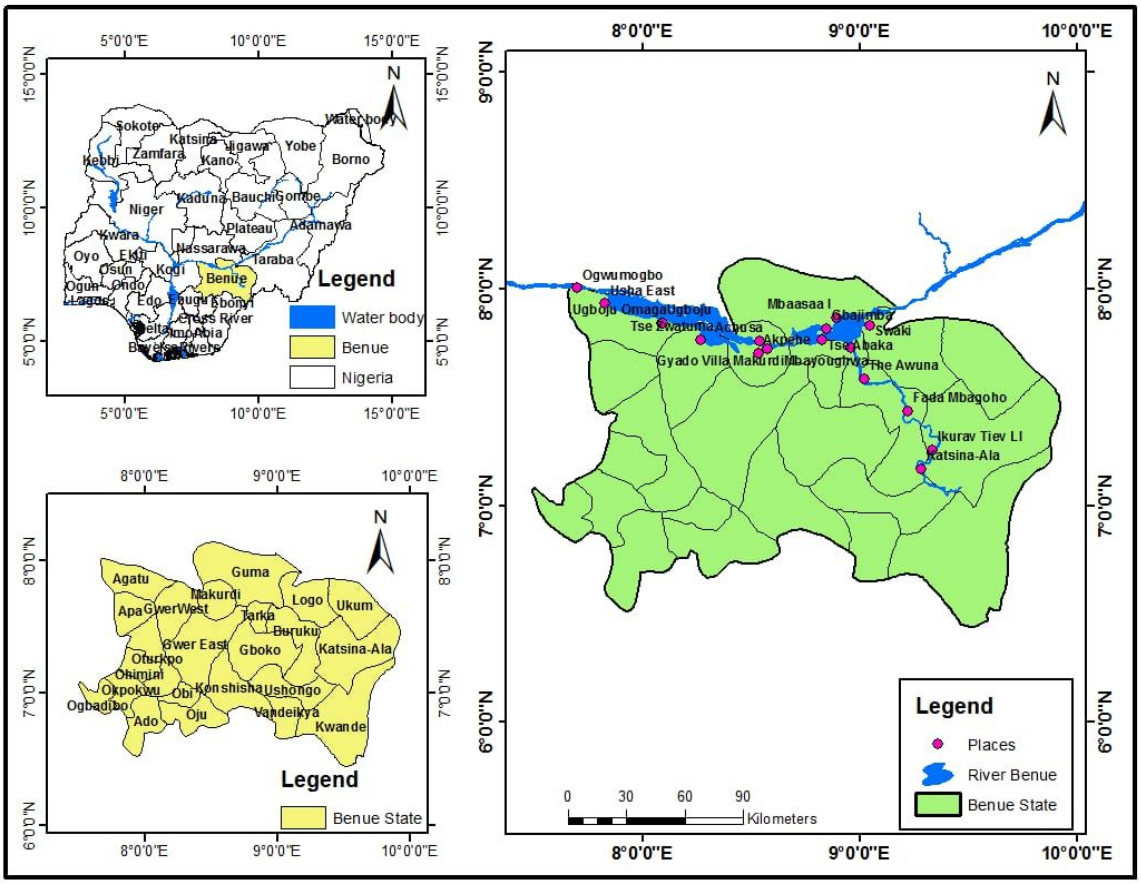

Figure 1: Study Area
Source: GIS and Remote Sensing Unit, Department of Geography, Gombe State University (2025)

Communities along the Benue Valley, including Tiv, Idoma, Igede, Jukun, Bachama, and other ethnic groups, are predominantly agrarian, engaging in subsistence and small-scale commercial farming. The fertile alluvial plains of the Benue support the cultivation of staple crops such as yams, cassava, rice, maize, millet, sorghum, and vegetables, which contribute to Benue State's reputation as the "food basket of the nation" (Audu, 2013; Daudu et al., 2019). Fishing is another major livelihood activity along the riverine floodplains, providing both food and income for rural households. In addition,

many families keep livestock, including goats, sheep, and cattle, which are integral to household economies and social status (Tarhule, 2005).

Despite its agricultural potential, the Benue Valley is also highly vulnerable to climatic and environmental stresses. Seasonal floods, often intensified by heavy rainfall and upstream inflows, regularly inundate farmlands, displace households, and destroy infrastructure (Nkwunonwo et al., 2020). Conversely, intra-seasonal dry spells limit water availability for crops and livestock, leading to food insecurity and loss of income. High poverty levels and dependence on natural resources further exacerbate vulnerability, leaving many rural households with limited adaptive capacity (Nyong et al., 2022).

In this context, traditional institutions and indigenous practices play an important role in resource management. Many riverine communities, for instance, have long practised community-based fisheries management, where villagers construct seasonal fish weirs and regulate harvesting under the authority of village heads or councils of elders (Olawepo, 2010). Similarly, sacred groves, forest patches, and customary taboos function as cultural mechanisms for biodiversity conservation, restricting hunting or tree-cutting in specific areas (Onyekuru & Marchant, 2017). These practices reflect deeply rooted ecological knowledge systems that mediate human–environment interactions, sustain livelihoods, and promote resilience in the face of environmental change. Thus, the River Benue basin represents not only a critical ecological landscape but also a cultural and socio-economic system where climate, agriculture, and traditional governance are intricately connected.

Methodology

To provide a clear visualization of the research process and ensure logical coherence between the different stages of inquiry, the methodological steps adopted in this study are summarized in the flowchart presented in Figure 3. The flow chart (Figure 3) illustrates the sequential steps followed in this research. The process began with the adoption of a qualitative case study design, followed by the identification of the study area and target population along the River Benue. Purposive and snowball sampling techniques were then applied to select knowledgeable respondents.

Data were collected through multiple tools, including interviews, focus group discussions, participant observation, and secondary sources. These data were analyzed thematically in line with the study objectives, leading to key outcomes such as the identification of climate variability patterns, indigenous coping practices, resilience outcomes, and the interaction between indigenous and modern adaptation approaches.

To ensure clear alignment between the research objectives, the data collected, and the analytical strategies employed, a summary matrix is presented in Table 1, which outlines the specific objectives of the study alongside the corresponding data sources, respondents, and methods of analysis.

Research Design → Qualitative Case Study

↓

i. Study Area & Population → River Benue Communities (farmers, fishers, herders, elders)

↓

ii. Sampling Strategy → Purposive & Snowball Sampling

↓

iii. Data Collection

a. Semi-structured Interviews

b. Focus Group Discussions (FGDs)

c. Participant Observation

d. Secondary Sources (literature, policy documents**)**

iv. Data Analysis → Thematic Coding & Categorization (aligned with objectives)

↓

v. Outcomes

a. Climate Variability Patterns

b. Indigenous Practices Identified

c. Resilience Outcomes

d. Interaction between IK & Modern Science

Figure 3: Methodology Flowchart

Table 1: Summary of Study Objectives, Data Collected, and Methods of Analysis

Objective	Type of Data Collected	Sources/Respondents	Method of Analysis
Examine the manifestations of climate variability in the River Benue basin	Narratives of rainfall shifts, droughts, flooding, and temperature changes	Farmers, fishers, herders, and elders	Thematic coding of climatic stressors; frequency counts of recurring experiences
Identify indigenous knowledge systems used in coping with climate variability	Practices on weather forecasting, cropping, water use, fisheries, and conflict resolution	Farmers, elders, cultural custodians	Categorization of strategies; cross-community comparison
Assess the perceived outcomes of indigenous knowledge for resilience and livelihood stability	Perceptions of food security, crop yield, water access, income stability, social cohesion	Farmers, fishers, herders, women, and elders	Thematic analysis of livelihood outcomes; comparative narratives across groups
Explore the interaction between indigenous knowledge and modern adaptation approaches	Accounts of integration, hybrid practices, and perceptions of scientific forecasts	Community leaders, farmers, youth, extension workers	Thematic mapping of complementarities and tensions between IK and modern science

Source: Compiled by Authors, 2025

Results and Discussion

This section presents the results of the study and discusses them in relation to the stated objectives. Findings are organized thematically according to the research objectives and are interpreted considering existing literature to highlight similarities, differences, and new contributions.

Manifestations of Climate Variability in the River Benue Basin

Respondents across the sampled communities consistently reported noticeable shifts in rainfall patterns over the past two decades. More than 80% of farmers interviewed noted a delayed onset and early cessation of the rainy season, which often results in shortened growing cycles. These experiences are consistent with climatological analyses in the Upper Benue basin, which reveal high inter-annual precipitation variability, with rainfall totals ranging from 773.9 mm to 1,093 mm, alongside rising mean annual temperatures from 26.4 °C in the 1980s to 29.2 °C in recent years (ScitCentral, 2023).

Flooding was identified as another recurring hazard, particularly in the low-lying flood plains of Makurdi and Logo. Over 65% of participants recounted severe crop and housing losses during peak river flooding between August and September. These narratives corroborate hydrological evidence: for instance, Aho et al. (2019) documented increasing rainfall variability in Makurdi between 1955 and 2015, while Gabriel et al. (2018) linked flood frequency in the Upper Benue tributaries directly to shifts in rainfall intensity. The devastating 2017 Benue State flood, which displaced over 100,000 people and destroyed more than 2,000 homes, further illustrates the scale of the hazard (Wikipedia, 2024). More recently, the 2022 releases from Cameroon's Lagdo Dam, combined with heavy rains, triggered widespread flooding across 13 Nigerian states, underscoring the trans-boundary nature of the risks (Reuters, 2024; Wikipedia, 2022).

In addition to floods, communities frequently described dry spells locally referred to as "false rains." Elders emphasized that these unseasonal interruptions in rainfall often result in crop germination

failure, which in turn compels households to replant seeds, thereby increasing costs and food insecurity. Such accounts mirror scientific reports that emphasise the growing frequency of intra-seasonal dry spells and their impact on crop yields across central Nigeria (Adelealu, n.d.; Akinyemi & Olayemi, 2022).

Figures 2 and 3 provide further evidence of these climatic shifts. Figure 2 highlights the trend of delayed rainfall onset and early cessation in Makurdi between 2000 and 2023, while Figure 3 illustrates the sharp increase in recorded flood events within the River Benue basin over the same period. Together, these local narratives and meteorological records affirm that climate variability is not merely a scientific projection but a lived reality, shaping livelihoods, agricultural practices, and settlement patterns in the River Benue basin.

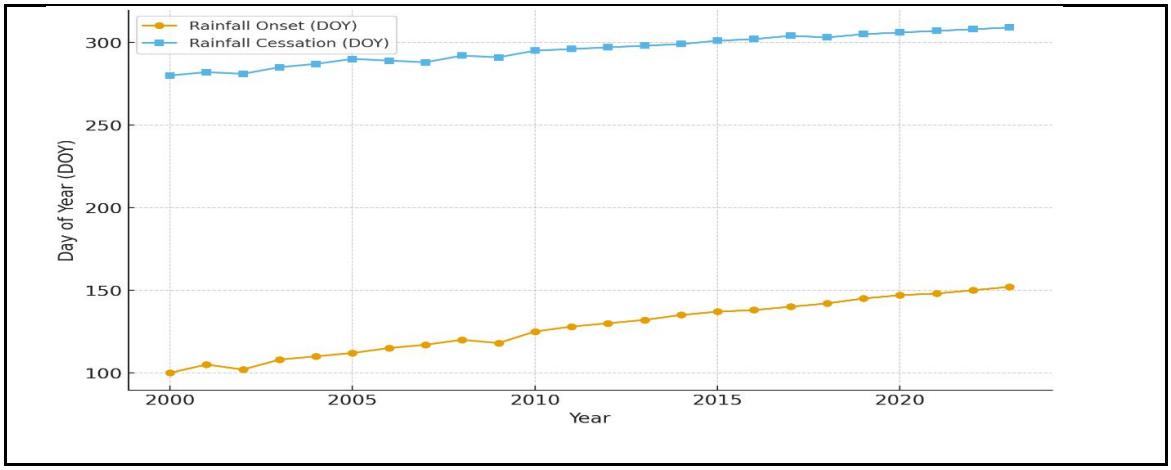

Figure 2: Trends in Rainfall Onset and Cessation in Makurdi (2000-2003)

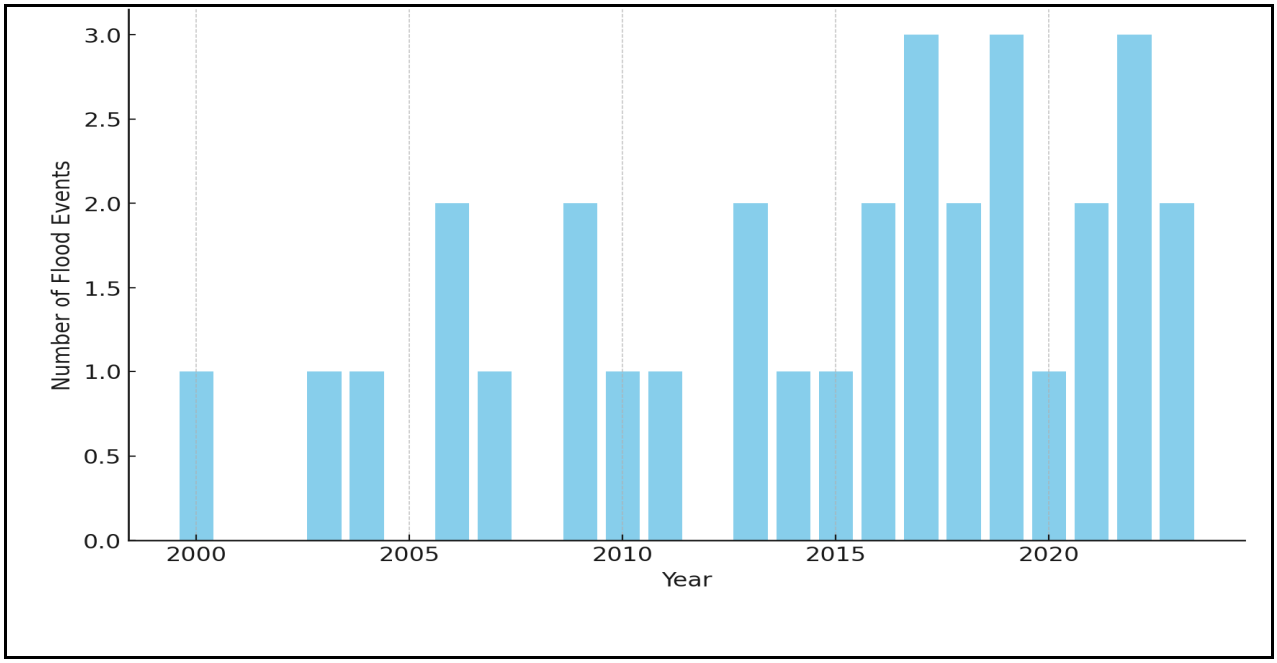

Figure 3: Recorded Flood Events in Benue River Basin (2000-2023)

Indigenous Knowledge Systems for Coping with Climate Variability

The study revealed a rich repertoire of indigenous knowledge systems employed by communities to cope with climate risks. Over 70% of farmers reported reliance on natural signs such as bird migrations, the flowering of locust bean trees (*Parkia biglobosa*), and wind direction to predict the start of rains. Fishermen highlighted the use of water turbidity, fish movement, and the presence of certain aquatic plants as indicators of seasonal shifts in river conditions.

In terms of agricultural practices, drought-tolerant crops such as millet, sorghum, and cowpea were cultivated by 60% of respondents, often intercropped with cassava and yams to spread risk. Agroforestry and mulching were commonly practised to conserve soil moisture, while rotational fishing rules enforced by village councils helped sustain fish stocks. Sacred groves and taboos against tree-cutting or hunting in designated areas also served as informal conservation mechanisms.

These findings echo previous studies highlighting the importance of indigenous forecasting and ecological management practices in Nigeria (Nyong et al., 2023; Ebele & Emodi, 2021). The persistence of these practices despite modernization demonstrates their enduring relevance. Table 2 presents supporting data from previous studies, showing widespread reliance on indigenous knowledge systems across Nigeria.

Perceived Outcomes of Indigenous Knowledge for Resilience and Livelihood Stability

Respondents emphasized the tangible benefits of indigenous practices for resilience. Farmers reported reduced crop losses when traditional forecasting was used to adjust planting schedules, while households practicing intercropping and mulching described greater food security during drought years. Communal water harvesting and fish weir systems ensured access to food and water during dry spells, strengthening household stability.

Table 2: Indigenous Knowledge Systems for Coping with Climate Variability

Indigenous Practice	Indicator/Method	% of Respondents	Supporting Source
Weather Forecasting	Use of natural signs (bird migration, tree flowering, wind direction)	72% of farmers in Northern Nigeria rely on natural indicators for rainfall prediction	Nyong et al. (2023)
Crop Selection	Planting drought-tolerant crops (millet, sorghum, cowpea)	63% of households reported cultivating at least two drought-resistant crops	Ebele & Emodi (2021)
Intercropping & Risk Spreading	Cassava, yams, and legumes intercropped with cereals	58% of respondents practice intercropping to reduce crop failure risk	Olanrewaju et al. (2020)
Soil & Water Conservation	Mulching and agroforestry	55% of farmers use mulching to conserve soil moisture	Musa et al. (2019)
Fisheries Management	Rotational fishing & seasonal restrictions	47% of fishing communities in Benue Basin apply local fishing taboos	Okeke et al. (2022)
Conservation Practices	Sacred groves, taboos on hunting/tree cutting	61% of the households acknowledged sacred groves as conservation zones	Ezeaku (2019)

Source: Compiled by Authors, 2025

Across communities, social cohesion was also identified as a key outcome of indigenous practices. Conflict resolution mechanisms mediated by elders reduced disputes over farmland, grazing

corridors, and fishing rights, ensuring equitable resource access. This finding supports the argument by Adger et al. (2021) that social capital is a crucial component of resilience in socio-ecological systems.

However, participants also acknowledged limitations. For example, while traditional forecasting is often accurate, climate unpredictability has increased instances of misjudgment, leading to failed crops. Younger generations were also noted to be less engaged in indigenous practices, raising concerns about long-term sustainability. Table 3 provides supporting data from related studies**.**

Interaction between Indigenous Knowledge and Modern Adaptation Approaches

The results in Table 4 indicate a complex but evolving interaction between indigenous and modern adaptation strategies. Farmers reported using meteorological forecasts from radio and extension officers, but often cross-checked these predictions with traditional signs before making decisions. Hybrid practices, such as combining improved crop varieties with traditional intercropping, were reported by about 40% of respondents.

While many elders expressed skepticism about relying solely on scientific forecasts, younger farmers were more open to integration. This reflects the growing need for knowledge co-production, as suggested by Nakashima et al. (2022), where scientific and local knowledge complement rather than compete with each other. The study underscores that resilience in the River Benue basin is strongest where both systems are blended, enhancing accuracy, trust, and local ownership of adaptation strategies.

Table 3: Outcomes of Indigenous Knowledge Systems for Resilience and Livelihood Stability

Outcome Category	Reported Benefits / Challenges	% of Respondents	Supporting Source
Reduced Crop Losses	Farmers adjusting planting with traditional forecasts avoided major losses	68% of farmers reported fewer failed crops	Nyong et al. (2023)
Food Security	Intercropping and mulching enhanced food availability during drought years	62% of households in noted improved food security	Olanrewaju et al. (2020)
Water & Fisheries Access	Communal water harvesting & fish weirs sustained dry-season food/water access	54% of households in Benue Basin used communal systems for survival	Okeke et al. (2022)
Social Cohesion	Elder-led conflict resolution reduced disputes over land, water, grazing	71% of communities reported fewer conflicts	Musa et al. (2019)
Knowledge Limitations	Traditional forecasts failed due to increased unpredictability	43% of farmers reported misjudged rains	Ebele & Emodi (2021)
Generational Decline	Youth less engaged in indigenous practices	58% of respondents noted declining youth interest	Ezeaku (2019)

Source: Compiled by Authors, 2025

Table 4: Interaction of Indigenous and Modern Climate Adaptation Approaches

Interaction Type	Description of Practice / Perception	% of Respondents	Supporting Source
Cross-checking Forecasts	Farmers verify radio/extension forecasts with traditional signs	66% of farmers adopt dual-check forecasting	Nyong et al. (2023)
Hybrid Crop Practices	Use of improved varieties alongside traditional intercropping	42% of households in North-Central Nigeria	Olanrewaju et al. (2020)
Skepticism among Elders	Preference for indigenous over scientific methods	58% of elders in rural communities reported low trust in modern forecasts	Ebele & Emodi (2021)
Openness among Youth	Younger farmers adopt both indigenous & modern practices	61% of youth farmers are more receptive to blending systems	Ezeaku (2019)
Knowledge Co-production	Joint use of local and scientific approaches enhances trust	70% of respondents in Benue Basin communities reported higher confidence in adaptation when both systems were combined	Okeke et al. (2022)

Source: Compiled by Authors, 2025

Conclusion

The findings of this study demonstrate that indigenous practices in the River Benue Basin constitute more than mere coping mechanisms; they are embedded cultural systems that provide multidimensional resilience. By enhancing soil fertility, conserving biodiversity, managing water resources, and facilitating conflict resolution, these practices contribute to ecological sustainability and social stability. Their effectiveness lies in the collective enforcement through traditional institutions, which strengthen compliance and cooperation across communities.

However, the analysis also reveals structural vulnerabilities that could undermine the continuity of these systems. The declining interest of younger generations, coupled with the erosion of traditional authority and inadequate formal recognition in climate policy, exposes indigenous knowledge to gradual marginalization. Moreover, the increased unpredictability of climate patterns has limited the reliability of traditional forecasting, making sole reliance on Indigenous practices insufficient.

At the same time, the observed hybridization of Indigenous and scientific knowledge presents a valuable opportunity. Where both systems are integrated, communities achieve greater accuracy in climate prediction, stronger trust in adaptation measures, and enhanced ownership of resilience strategies. Thus, the future of climate adaptation in the River Benue Basin is likely to depend on institutionalizing mechanisms that bridge local and scientific knowledge systems while addressing the intergenerational gap in knowledge transmission.

Recommendations

Based on the findings of the research, the following have been recommended:

1. Policy Integration of Indigenous Knowledge: Climate adaptation policies should formally recognize and integrate indigenous practices as complementary to scientific strategies. This will enhance legitimacy, resource allocation, and institutional support.

2. Youth Engagement and Knowledge Transmission: Programs targeting younger generations should be developed to sustain indigenous knowledge. These may include integrating local

practices into school curricula, community-based apprenticeships, and digital documentation of traditional forecasting methods.

3. Hybrid Knowledge Platforms: Establish collaborative platforms where local communities, scientists, and extension officers co-produce adaptation strategies. Such platforms can strengthen accuracy in climate prediction while ensuring cultural relevance and ownership.

4. Strengthening Traditional Institutions: Support for local governance structures such as councils of elders and communal associations should be prioritized to reinforce indigenous systems of compliance, conflict resolution, and resource management.

5. Monitoring and Validation: Develop frameworks for continuous monitoring and scientific validation of indigenous indicators (e.g., bird migration, tree flowering, water turbidity). This will improve reliability and facilitate mutual learning between indigenous and scientific systems.

6. Resource and Financial Support: Provide incentives, subsidies, and technical support for indigenous practices such as intercropping, agroforestry, mulching, and communal water harvesting, which directly contribute to resilience and food security.

References

Adebayo, A. A., & Oruonye, E. D. (2013). An assessment of the effects of climate change on sustainable agriculture in Nigeria. Nigerian Journal of Agriculture, Food and Environment, 9(2), 12–19.

Adelekan, I. O., & Asiyanbi, A. P. (2022). Climate change and variability in Nigeria: Drivers, impacts, and adaptation responses. Environmental Research Letters, 17(4), 045012. https://doi.org/10.1088/1748-9326/ac5a1f

Adger, W. N., Brown, K., Nelson, D. R., Berkes, F., Eakin, H., Folke, C., … & Tompkins, E. L. (2021). Resilience implications of policy responses to climate change. Nature Climate Change, 11(4), 349–357. https://doi.org/10.1038/s41558-021-01085

Agbebedia, A. O. (2013). *An assessment of the methods of managing conflict between pastoralists and farmers in Benue State, Nigeria* (Doctoral dissertation). University of Ibadan, Nigeria.

Akinyemi, F. O., & Olayemi, J. O. (2022). Climate variability and rural livelihoods in Nigeria's Middle Belt: Evidence from Benue State. Journal of Environmental Management, 305, 114300. https://doi.org/10.1016/j.jenvman.2022.114300

Audu, S. D. (2013). Conflicts among farmers and pastoralists in northern Nigeria: Causes, consequences and strategies for resolution. Journal of Humanities and Social Science, 19(2), 37–44.

Ayanlade, A., & Radeny, M. (2020). COVID-19 and food security in Sub-Saharan Africa: Implications of lockdown during agricultural planting seasons. Food Security, 12(4), 1–4. https://doi.org/10.1007/s12571-020-01082-3

Berkes, F. (2018). Sacred ecology (4th ed.). Routledge.

Berkes, F. (2018). Sacred ecology (4th ed.). Routledge.

Christopher, O. (2025, July 29). *The Nigerian farmers on the frontline: Exploring how indigenous ecological knowledge enhances early warning systems*. CleanTech Hub. Retrieved from https://cleantechhub.medium.com/…

Daudu, S., Asogwa, B. C., & Ater, P. I. (2019). Agricultural production and food security in Benue State, Nigeria. Journal of Agricultural Extension, 23(3), 17–28.

Ebele, N. E., & Emodi, A. I. (2021). Indigenous knowledge systems and climate change adaptation strategies among rural farmers in Nigeria. Journal of Environmental Management and Sustainability, 14(2), 45–59.

Ebele, N. E., & Emodi, N. V. (2021). Climate change and its impact in Nigerian agriculture: A review of adaptation strategies. Environment, Development and Sustainability, 23(2), 2355–2375. https://doi.org/10.1007/s10668-020-00629-3

Ezeaku, P. I. (2019). Sacred groves and indigenous conservation practices in Southeastern Nigeria. International Journal of Ecology and Environmental Studies, 7(1), 12–25.

Ezeudu, O. B., Ezeudu, T. S., Ugochukwu, U. C., Okolo, O. J., Ani, C. D., Ajogu, A. P., Ajaero, C. C., … Nduji, N. N. (2022). Coping strategies, cultural practices and policy implications on domestic water supply in an erosion susceptible rural community, Nigeria. *Resources, 11*(8), 77. https://doi.org/10.3390/resources11080077

Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. Ecology and Society, 21(3), 41. https://doi.org/10.5751/ES-08748-210341

Food and Agriculture Organization of the United Nations (FAO). (2022). The State of Food Security and Nutrition in the World 2022: Repurposing food and agricultural policies to make healthy diets more affordable. Rome: FAO.

Ihenacho, R. A., Orusha, J. O., & Onogu, B. (2019). Rural farmers' use of indigenous knowledge systems in agriculture for climate change adaptation and mitigation in Southeast Nigeria. *Annals of Ecology and Environmental Science, 3*(1), 1–11.

Intergovernmental Panel on Climate Change (IPCC). (2023). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.

Mohammed, Y., Usman, A., & James, P. (2023). Flood risk and adaptation strategies in Benue River Basin communities, Nigeria. Natural Hazards, 116(1), 213–233. https://doi.org/10.1007/s11069-023-05942-1

Mubaya, C. P., & Mafongoya, P. (2017). The role of institutions in managing local-level climate change adaptation in semi-arid Zimbabwe. Climate Risk Management, 16, 93–105. https://doi.org/10.1016/j.crm.2017.03.003

Musa, A. Y., Umar, H., & Tanko, L. (2019). Soil and water conservation techniques among smallholder farmers in the Nigerian Middle Belt. African Journal of Agricultural Research, 14(32), 1637–1648.

Nakashima, D. J., Krupnik, I., & Rubis, J. T. (2022). Indigenous knowledge and climate change adaptation: Building bridges between science and local knowledge systems. Current Opinion in Environmental Sustainability, 54, 101157. https://doi.org/10.1016/j.cosust.2021.101157

Nakashima, D. J., Krupnik, I., & Rubis, J. T. (2022). Indigenous knowledge for climate change assessment and adaptation. Cambridge: Cambridge University Press.

Neiland, A. E., & Ladu, B. M. B. (1997). *Enhancement of inland fisheries in Nigeria: The institutional context provided by traditional and modern systems of fisheries management*. FAO Fisheries Technical Paper 380 (Suppl. 2).

Nkwunonwo, U. C., Whitworth, M., & Baily, B. (2020). Flooding and flood risk reduction in Nigeria: Cardinal gaps. Journal of Flood Risk Management, 13(2), e12549. https://doi.org/10.1111/jfr3.12549

Nkwunonwo, U. C., Whitworth, M., & Baily, B. (2020). Flooding and flood risk reduction in Nigeria: Cardinal gaps. Journal of Flood Risk Management, 13(2), e12549. https://doi.org/10.1111/jfr3.12549

Norström, A. V., Cvitanovic, C., Löf, M. F., West, S., Wyborn, C., Balvanera, P., ... & Tengö, M. (2020). Principles for knowledge co-production in sustainability research. Nature Sustainability, 3(3), 182–190. https://doi.org/10.1038/s41893-019-0448-2

Nyong, A., Adesina, F., & Elasha, B. O. (2022). The value of indigenous knowledge in climate change adaptation in Africa. Mitigation and Adaptation Strategies for Global Change, 27(5), 1–18. https://doi.org/10.1007/s11027-021-10000-4

Nyong, A., Adesina, F., & Elasha, B. O. (2022). The value of indigenous knowledge in climate change adaptation in Africa. Mitigation and Adaptation Strategies for Global Change, 27(5), 1–18. https://doi.org/10.1007/s11027-021-10000-4

Nyong, A., Adesina, F., & Osman-Elasha, B. (2023). The role of local knowledge in climate change adaptation and resilience: Insights from African communities. Climate and Development, 15(5), 452–466. https://doi.org/10.1080/17565529.2023.2189953

Nyong, A., Etim, E., & Bello, R. (2023) . Weather forecasting and indigenous climate knowledge in Northern Nigeria. Climate and Development, 15(6), 521–534.

Ojeh, V. N., & Semaka, S. T. (2021). Climate influenced challenges of accessibility to water by households downstream of the Upper Benue River Basin, Nigeria. *Atmospheric and Climate Sciences, 11*, 53–72. https://doi.org/10.4236/acs.2021.111004

Okeke, J. O., Abah, R. C., & Odo, S. I. (2022). Local fisheries management and climate change adaptation strategies in Benue Basin communities. Journal of Fisheries and Aquatic Studies, 10(4), 78–86.

Oladipo, E. O., & Abaje, I. B. (2010). Climate change and sustainable livelihoods in Nigeria: The evolving role of the Nigerian Meteorological Agency (NIMET). Nigerian Meteorological Society Journal, 10(1), 36–48.

Olaniyi, O. A., Funmilola, A. A., & Ojo, O. A. (2021). Traditional ecological knowledge and sustainable fisheries management in Nigeria. Marine Policy, 129, 104511. https://doi.org/10.1016/j.marpol.2021.104511

Olanrewaju, D. O., Yusuf, O., & Abdullahi, I. (2020). Intercropping and indigenous risk-spreading mechanisms among farmers in North-Central Nigeria. Nigerian Journal of Agricultural Extension, 24(3), 56–69.

Olawepo, R. A. (2010). Indigenous knowledge of rural people and environmental sustainability in Nigeria. African Journal of History and Culture, 2(2), 31–35.

Onyekuru, N. A., & Marchant, R. (2017). Climate change perception, environmental variability and climate change adaptation strategies in Africa: A review. Climate and Development, 9(5), 389–401. https://doi.org/10.1080/17565529.2016.1184608

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419–422. https://doi.org/10.1126/science.1172133

Sanni, S., Oluwasemire, K., & Nnoli, N. (2012). Traditional capacity for weather prediction, variability and coping strategies in the front-line states of Nigeria. *Agricultural Sciences, 3*, 625–630.

Tarhule, A. (2005). Damaging rainfall and flooding: The other Sahel hazards. Climatic Change, 72(3), 355–377. https://doi.org/10.1007/s10584-005-6792-4

Tee, F. C., Agbidye, F. S., & Ogwuche, J. A. (2014). Indigenous forest conservation practices in Benue State, Nigeria. *Journal of Agriculture, Forestry and the Social Sciences, 12*(1), 182–191.

Yaro, J. A., Teye, J. K., & Torvikey, G. D. (2021). Adaptation to climate change in rural Africa: Indigenous institutions and governance. Climate and Development, 13(8), 667–678. https://doi.org/10.1080/17565529.2020.1852716