JOURNAL OF AGRICULTURAL ECONOMICS, EXTENSION & SCIENCES
Official Journal of the College of Agricultural Economics and Extension
www.jaees.org
www.uam.edu.ng
Jaees Vol. 14 No. 2 2026, Page 103-113
ISSN (Print) 2545-5179, ISSN (Online) 2714-5018

ANALYSIS OF COMMUNITY-LED CLIMATE CHANGE ADAPTATION AND HOUSEHOLD RESILIENCE IN MAKURDI METROPOLIS, BENUE STATE, NIGERIA

[1]Icheme, J. O., [2]Demenongu, T. S. and [3]Obafemi, A. O.
[1] & [3]Department of Sustainable Social Development, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria
[2]Joseph Sarwuan Tarka University, Makurdi-Benue State Nigeria, Department of Agricultural Extension & Rural Development
Email: ichemejohnode@gmail.com Tel: 07037588572

Abstract
The study analyzed the role of community-led climate change adaptation and household resilience in Makurdi local Government Area of Benue State. Climate-related flooding is a persistent threat to households and livelihoods in Makurdi metropolis, yet much of the formal response to climate risk remains centered on infrastructure, emergency relief and institutional interventions. This study analyses the role of community-led adaptation and local knowledge in strengthening household resilience in four flood-prone communities of Makurdi: Wadata, Wurukum, Northbank and Achusa/Nyiman Layout. A mixed-method design was used. Quantitative data were obtained from 195 household heads selected through purposive and proportionate sampling, while qualitative perspectives were obtained through focus group discussions and key informant interviews. Descriptive statistics and multiple regression were used for the quantitative analysis, while qualitative evidence was interpreted thematically. The findings showed that majority (75.9%) of the households had experienced flooding, and 83.1% were aware of local methods for responding to climate risks. Crop diversification (67.7%), early or delayed planting (64.6%), indigenous flood prediction (60.5%) and communal drainage desilting (56.9%) were among the most commonly reported practices. Community institutions were also important: Majority (72.3%) of respondents belonged to at least one community group and 71.3% agreed or strongly agreed that such institutions helped preparedness. Government or NGO support reached 52.3% of the respondents, but integration of local knowledge remained incomplete. Regression results indicate that local knowledge was the strongest predictor of household resilience ($\beta = 0.354$, $p < 0.001$), followed by socio-economic characteristics ($\beta = 0.231$, $p = 0.002$) and community institutions ($\beta = 0.198$, $p = 0.001$). Government/NGO support had a positive effect ($\beta = 0.127$, $p = 0.030$), whereas geographic exposure had a negative effect ($\beta = -0.142$, $p = 0.024$). The model explained 62.1% of the variation in household resilience ($R^2 = 0.621$; adjusted $R^2 = 0.607$). The study concludes that community-led adaptation is an active and practical component of household resilience, but it effectiveness is strengthened when local knowledge, social organization and formal scientific infrastructural and financial support are deliberately connected. It recommends participatory climate governance, predictable funding for community adaptation, systemic documentation of local knowledge, stronger community- government collaboration, improved drainage and and flood control infrastructure, and risk sensitive urban planning.

Keywords: Analysis, Community-led, Adaptation, Climate Change, Household Resilience.

1.0 Introduction

Climate change is increasingly experienced not as an abstract global phenomenon but as a set of everyday disruptions to livelihoods, settlements, food systems and social relations. Changes in rainfall patterns, rising temperatures and more frequent or intense extreme events have increased the exposure of many African communities to climate-related hazards (IPCC, 2014, 2022). In Nigeria, the implications are particularly serious because a large proportion of livelihoods remain climate-sensitive. Farming, fishing, informal trading and other livelihood activities depend directly or indirectly on environmental conditions. In urban areas, rapid population growth, settlement expansion, inadequate drainage and poor waste management can convert intense rainfall into damaging floods.

Makurdi presents a particularly useful setting for examining this problem. The city lies along the River Benue and contains neighborhoods in which households experience recurrent flooding. Flood events affect homes, roads, farms, commercial activities and household assets, while also creating risks to food security and public health. Previous work cited in the study indicates that poor urban planning, settlement on flood-prone land and inadequate drainage contribute to the vulnerability of urban residents (Douglas et al., 2008; Adelekan, 2016; Etuonovbe, 2019). The problem is therefore not simply the amount of rainfall received; it is the interaction between climatic hazards, physical exposure, socio-economic conditions and the capacity of institutions to respond.

Formal climate adaptation has an important role in reducing these risks. Early warning systems, drainage infrastructure, emergency management, land-use planning and livelihood support can reduce exposure and help households recover. However, formal interventions do not operate in a social vacuum. Households have their own histories of living with floods and have developed practical ways of reading environmental changes, protecting property, adjusting agricultural activities, sharing information and mobilizing labour. Such practices constitute local knowledge: knowledge accumulated through long-term interaction with the local environment and transmitted through experience, social relationships and community institutions.

The distinction between formal and local responses is important because adaptation is ultimately judged by what happens at household and community level. A technically sound intervention may produce limited results if residents do not trust it, cannot maintain it, or find that it does not fit local conditions. Conversely, a locally developed practice may be affordable and trusted but insufficient when hazards exceed historical experience. The most promising approach is therefore not to romanticize local knowledge or reject scientific knowledge, but to identify where the two can complement each other

2.0 Objectives of the Study

The broad objective was to analyse the role of community-led climate change adaptation and local knowledge in strengthening household resilience in Makurdi metropolis. The specific objectives were to:

(1) describe socio-economic characteristics of housedhold head in the study area
(2) identify forms of local knowledge used to respond to climate risks
(3) ascertain the effectiveness of community-led institutions in building resilience
(4) analyze the interaction between local knowledge and government-led interventions
(5) identify challenges limiting the integration of community-led adaptation into formal climate governance.

3.0 Methodology

A mixed-method design was adopted because the research questions required both measurable household evidence and contextual explanations. The quantitative component used a cross-sectional household survey to measure socio-economic characteristics, flood exposure, adaptation practices, and institutional participation, and resilience outcomes. The qualitative

component used focus group discussions and key informant interviews to understand contextual explanations of community experiences, local knowledge, institutional relationships and barriers to formal integration. The combination of the two components allowed numerical patterns to be interpreted alongside community narratives.

The study was carried out in Makurdi metropolis, the capital of Benue State in Nigeria's North-Central region. The city is located around 7°44′N and 8°32′E and is divided by the River Benue. It functions as an administrative, commercial and agricultural centre and has experienced substantial urban growth. The climate is tropical wet and dry, with the rainy season generally extending from April to October and the dry season from November to March. Annual rainfall is reported in the study as approximately 1,200–1,800 mm, with heavier rainfall generally occurring between July and September.

The four selected communities—Wadata, Wurukum, Northbank and Achusa/Nyiman Layout, were purposively chosen because of recurrent flooding, exposure to the River Benue or poor drainage conditions, and evidence of community adaptation. Their selection allowed the study to focus on places where households regularly confront climate-related risks and where local responses can be observed.

The population consisted of households in the four selected communities. Community and administrative records used in the study estimated 1,950 households: 450 in Wadata, 600 in Wurukum, 400 in Achusa/Nyiman Layout and 500 in Northbank. A multistage sampling procedure was used. Communities were purposively selected; household lists were compiled and checked with local authorities; and 10% of households in each community were selected proportionately, producing a sample of 195 households. The head of each selected household served as the respondent.

Table 1: Sample size selection plan

Community	Sampling Frame for households	Sample size (0.1)
Wadata	450	45
Wurukum	600	60
Achusa/Nyiman Layout	400	40
Northbank	500	50
Total	1,950	195

The proportional approach ensured that each selected community contributed respondents according to its estimated household population. The study therefore combined purposive selection of information-rich locations with proportionate household selection within those locations.

Three instruments were used: a structured questionnaire, a focus group discussion guide and a key informant interview guide. The questionnaire contained sections on socio-economic characteristics, climate experience, local knowledge, community institutions, socio-economic influences on adaptation, interaction with government interventions, barriers to integration and resilience outcomes. Likert-type items were used for perceptions of effectiveness and institutional challenges. The FGD guide explored community histories of flooding, indigenous coping practices, collective action and barriers. Key informants included relevant community and institutional actors such as traditional leaders, environmental officers, emergency-management personnel and representatives of environmental organizations.

The instruments were reviewed for content validity by persons with relevant expertise in climate adaptation, sustainable development and research methodology. A pilot exercise was conducted in a flood-prone community outside the selected study sites. Feedback from the pilot was used to improve wording, clarity and relevance. The study reports Cronbach's alpha as the

reliability procedure for Likert-scale items and follows the conventional social-science threshold of 0.70.

Questionnaire responses were coded and analyzed using SPSS. Frequencies, percentages, means and standard deviations were used to summarize the data. Multiple regression was used to estimate the combined contribution of socio-economic characteristics, local knowledge, community institutions, government/NGO support and geographic exposure to household resilience. Qualitative data were examined through thematic content analysis and used to provide contextual interpretation. The regression model was specified as

$$RES_i = \beta_0 + \beta_1 SEC_i + \beta_2 LK_i + \beta_3 INS_i + \beta_4 GOV_i + \beta_5 LOC_i + \varepsilon_i$$

where RES represents household resilience; SEC socio-economic characteristics; LK local knowledge; INS community institutions; GOV government/NGO support and policy integration; LOC geographic exposure; and ε the error term. Statistical tests were evaluated at $p < 0.05$. The study did not manipulate variables or assign treatment and control groups; consequently, the research is observational rather than experimental despite the earlier consideration of a quasi-experimental approach.

4.0 Results and Discussion

4.1 Socio-economic Characteristics

The respondents were household heads. Males constituted 60.5% and females 39.5%. The largest age group was 31–45 years (45.6%), followed by respondents aged 30 years or less (27.7%) and those aged 46 years or more (26.7%). Married respondents constituted 62.1%. Educational attainment was concentrated at primary and secondary levels, with 22.1% reporting more than 12 years of schooling.

Table 2: Socio economic characteristics of household heads (n=195)

Characteristic	Category	N	%
Sex	Male	118	60.5
	Female	77	39.5
Age (Years)	≤30	54	27.7
	31–45	89	45.6
	46+	52	26.7
Marital status	Single	48	24.6
	Married	121	62.1
	Widowed	16	8.2
	Divorced	10	5.1
Education	0–6 years	63	32.3
	7–12 years	89	45.6
	Above 12 years	43	22.1
occupation	Farming	74	37.9
	Fishing	21	10.8
	Treading	39	20.0
	Artisan	26	13.3
	Civil servant	18	9.2
	Others	17	8.7

Household size	1 – 4 persons	58	29.7
	5 – 8 persons	93	47.7
Monthly Income	Below 50,000	87	44.6
	50,000 – 100, 000	71	36.4
	Above 100,000	37	19.0

Farming was the main occupation of 37.9% of respondents, followed by trading (20.0%), artisanal work (13.3%), fishing (10.8%) and civil service (9.2%). Nearly half of the households (47.7%) contained five to eight persons. Income levels

were relatively low: 44.6% earned below ₦50,000 per month, 36.4% earned ₦50,000–₦100,000 and only 19.0% earned above ₦100,000. More than half of respondents (54.9%) had lived in their communities for more than ten years.
These characteristics matter because adaptation choices are shaped by both need and capacity.

The large share of households dependent on farming and informal livelihoods increases exposure to climate shocks, while low income can constrain investments in durable adaptation. At the same time, long residence can provide accumulated environmental knowledge and strong community relationships.

4.2 Community Institutions

Community participation was high. About 72.3% of respondents belonged to at least one community group. Religious organisations were the most commonly reported group (57.4%), followed by farmers' cooperatives (43.1%), market associations (36.4%), women's associations (34.4%), youth groups (30.3%) and traditional councils (24.6%).

Table 3: Community Institutions (n=195)

Indicator	**Response**	**n**	**%**
Member of community group	Yes	141	72.3
	No	54	27.7
Groups help preparednesss	Strongly agree	59	30.3
	Agree	83	42.6
Groups coordinate activities	Strongly agree	48	24.6
	Agree	86	44.1
Institutional effectiveness	Very effective	52	26.7
	Effective	87	44.6

Overall, 71.3% either agreed or strongly agreed that community groups helped preparedness, and 68.7% either agreed or strongly agreed that they coordinated activities such as drainage clearing, warning dissemination or evacuation. Similarly, 71.3% rated community institutions as effective or very effective. The result suggests that social organisation is a practical component of resilience rather than a peripheral feature of community life.

4.3 Interaction between Local Knowledge and Formal Interventions

Government or NGO adaptation support had reached 52.3% of respondents, while 47.7% reported no such support. Relief materials were the most commonly reported form of assistance (37.9%), followed by flood-control infrastructure (31.3%), training/awareness (29.7%) and early warning systems (24.1%). The distribution suggests that formal support exists but does not reach all households and is often concentrated on relief and physical interventions.

Table 4: Interaction between Local Knowledge and Formal Interventions (n=195)

Indicator	Category	n	%
Government/NGO support	Yes	102	52.3
	No	93	47.7
Support received	Flood-control infrastructure	61	31.3
	Relief materials	74	37.9
	Training/awareness	58	29.7
	Early warning	47	24.1
Government programmes consider local knowledge	Strongly agree	38	19.5
	Agree	72	36.9
	Disagree	53	27.2
	Strongly disagree	32	16.4
Collaboration improves outcomes	Strongly agree	66	33.8
	Agree	79	40.5

A combined 56.4% agreed or strongly agreed that government programmes considered local knowledge. Although this is more positive than negative, it also means that a substantial minority did not perceive meaningful integration. In contrast, 74.3% agreed or strongly agreed that collaboration between community groups and government improves adaptation outcomes. The difference is important: residents appear to value collaboration even though they do not consistently experience it in planning and implementation.

4.4 Climate Change Experience and Exposure

Flooding was the dominant climate-related hazard. Overall, 75.9% of respondents had experienced flooding. Forty percent reported annual flooding and 44.1% reported occasional flooding, while 15.4% reported rare flooding. Crop failure was reported by 62.1%, food shortage by 49.2%, loss of property by 42.6% and disease outbreaks by 34.9%. These results demonstrate that flooding is not an isolated physical event; it affects production, consumption, housing, health and household economic security.

Table 5: Climate Change Experience and Exposure (n=195)

Climate indicator	Category	n	%
Experienced flooding	Yes	148	75.9
	No	47	24.1
Flood occurrence	Every year	79	40.5
	Occasionally	86	44.1
	Rarely	30	15.4
Major problem	Flooding	148	75.9
	Crop failure	121	62.1
	Food shortage	96	49.2
	Loss of property	83	42.6
	Disease outbreak	68	34.9

The high level of exposure strengthens the case for adaptation that is continuous rather than episodic. Recurrent hazards require households and institutions to prepare before flooding, respond quickly during events and recover in ways that reduce future vulnerability.

4.5 Forms of Local Knowledge Used for Adaptation

Awareness of local adaptation methods was high: 83.1% of respondents said they knew traditional or local methods for coping with climate risks. The most frequently reported practices were crop diversification (67.7%), early or delayed planting (64.6%), indigenous flood prediction (60.5%), communal drainage desilting (56.9%), raised house foundations (53.3%), sandbags or embankments (49.7%) and traditional seed preservation (45.6%).

Table 6: Forms of Local Knowledge Used for Adaptation (n=195)

Local practice	N	%
Indigenous flood prediction	118	60.5
Raised house foundations	104	53.3
Sandbags/embankments	97	49.7
Crop diversification	132	67.7
Traditional seed preservation	89	45.6
Communal drainage desilting	111	56.9
Early/delayed planting	126	64.6

The pattern is significant because it shows that local adaptation is diverse. Some practices operate at household level, such as raising foundations; others are collective, such as drainage desilting; and others are livelihood-based, such as crop diversification and changing planting dates. This diversity allows households to respond to different dimensions of climate risk rather than relying on one intervention.

Use was not necessarily constant. About 37.4% reported always using local practices and 46.7% used them sometimes. Only 15.9% reported rare use. Perceived effectiveness was also positive: 31.8% strongly agreed and 45.1% agreed that local knowledge was effective in reducing climate risks, producing a mean score of 3.00 (SD = 0.89). This suggests that local knowledge remains an active part of adaptation, although households may combine it with modern information, infrastructure and external assistance.

The prominence of crop diversification is particularly relevant for food security. Where flooding or uncertain rainfall can damage a single crop, diversified production can spread risk. Changes in planting dates show that farmers are responding to changing rainfall expectations. Indigenous flood

prediction provides an additional layer of environmental awareness, while communal drainage work demonstrates that local knowledge can be translated into collective physical action.

The findings are consistent with the broader literature that recognizes indigenous knowledge as an important adaptation resource (Nyong et al., 2007; Naess, 2013; Berkes, 2017). At the same time, the study does not imply that local practices can replace formal adaptation. Their value is greatest when they are recognized, strengthened and linked to reliable scientific information, infrastructure and institutional support.

4.6 Challenges to Integrating Community-led Adaptation

All four identified barriers recorded mean scores above the 2.50 cut-off. Inadequate funding was the most prominent challenge (mean = 3.15), followed by lack of government recognition (3.07), poor coordination between stakeholders (2.91) and undervaluation of cultural knowledge (2.81)

Table 6: Challenges to Integrating Community-led Adaptation (n=195)

Challenge	Mean	SD
Lack of government recognition	3.07	0.87
Inadequate funding	3.15	0.84
Poor coordination	2.91	0.93
Cultural knowledge undervalued	2.81	0.98

The results indicate that the principal obstacles are institutional rather than a lack of community willingness. Community members may possess knowledge and organisational capacity but still be unable to sustain adaptation activities without resources, recognition and coordination. Inadequate funding can interrupt activities such as drainage maintenance or local preparedness. Lack of recognition can prevent community representatives from participating in formal planning. Poor coordination can result in duplication, gaps or conflicting interventions.

The undervaluation of local knowledge has a deeper implication. When policy actors assume that useful climate knowledge must originate from technical institutions, information generated by residents can remain outside official systems. This may weaken trust and reduce the relevance of interventions. The literature similarly identifies tokenistic participation and weak institutional recognition as barriers to locally led adaptation (Agrawal, 2008; Ajibade, 2019; UNDP, 2021).

4.7 Regression Analysis

Multiple regressions were used to estimate the relative contribution of socio-economic characteristics, local knowledge, community institutions, government/NGO support and geographic exposure to household resilience. The model was statistically significant ($F = 44.38$, $p < 0.001$) and explained 62.1% of the variation in resilience outcomes. The adjusted R^2 of 0.607 indicates that the explanatory performance remained strong after adjustment for the number of predictors.

Table 8: Regression Analysis

Predictor	B	SE	t	p
Intercept	0.452	0.217	2.08	0.039
Socio-economic characteristics	0.231	0.072	3.21	0.002
Local knowledge practices	0.354	0.065	5.44	<0.001
Community institutions	0.198	0.061	3.25	0.001

Government/NGO support	0.127	0.058	2.19	0.030
Geographic exposure	−0.142	0.062	−2.29	0.024

Local knowledge had the largest positive coefficient ($\beta = 0.354$, $p < 0.001$). Holding the other predictors constant, stronger use of local knowledge was associated with higher household resilience.

This is consistent with the high levels of reported awareness and use of indigenous practices. It also supports the argument that local knowledge is not merely symbolic; it has measurable relevance to household outcomes.

Socio-economic characteristics were also significant ($\beta = 0.231$, $p = 0.002$). This result is consistent with the descriptive finding that income, education, gender roles and household size influence adaptation choices. Households with more resources or information may have a wider range of adaptation options, while households with limited resources may depend more heavily on low-cost local practices.

Community institutions had a positive and significant effect ($\beta = 0.198$, $p = 0.001$). The result confirms the importance of collective action. Membership alone is not the whole explanation; the finding suggests that functioning social networks, information channels and collective arrangements contribute to resilience. Government/NGO support was also positive and significant ($\beta = 0.127$, $p = 0.030$), but its coefficient was smaller than those of local knowledge, socio-economic characteristics and community institutions. This indicates that external support is valuable but does not substitute for local capacity.

Geographic exposure was negatively associated with resilience ($\beta = -0.142$, $p = 0.024$). Households facing greater exposure to flood-prone locations were less resilient, even after accounting for other variables. This result highlights an important policy lesson: strengthening household capacity alone cannot eliminate vulnerability when people remain exposed to severe physical hazard.

5.0 Conclusion and Recommendations

5.1 Conclusion

Based on the findings of the study, it was concluded that households are not passive recipients of climate impacts. They actively observe their environment, adjust livelihoods, maintain local infrastructure, share information and participate in community organizations. Local knowledge remains widely used, and the regression analysis identifies it as the strongest predictor of household resilience among the variables considered.

The study also revealed that resilience is multidimensional. Local knowledge matters, but it operates alongside socio-economic resources, community institutions, formal support and geographic exposure. Community institutions contribute through collective action and social support. Government and NGO interventions have a positive role, especially where they provide infrastructure, training, relief and information. Yet repeated exposure to flood risk can reduce resilience even when households possess strong adaptive capacities.

The major barriers identified by respondents, insufficient funding, weak government recognition, poor coordination and undervaluation of indigenous knowledge. This shows that the challenges are not a shortage of community initiative. Rather, there is a governance gap between community capacity and formal systems.

5.2 Recommendations

It was therefore recommended that local knowledge should be formally documented and incorporated into climate adaptation planning, and embrace Community- Led development models that will help the communities to build upon their local resources, instead of imposing external

solution. Also, it was established the need of government and development partners to establish predictable funding windows for community-based adaptation, rather than relying mainly on short-term emergency assistance.

Furthermore, the negative effect of geographic exposure shows that household resilience cannot compensate indefinitely for high physical risk, therefore it was recommended that the community-led adaptation should be combined with structural risk reductions like drainage improvement, protection of waterways, appropriate land use planning and risk sensitive infrastructure.

References

Adelekan, I. O. (2016). Vulnerability of poor urban coastal communities to climate change in Lagos, Nigeria. Environment and Urbanization, 22(2), 433–450.

Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. Economic Geography, 79(4), 387–404.

Adger, W. N., Barnett, J., Brown, K., Marshall, N., & O'Brien, K. (2013). Cultural dimensions of climate change impacts and adaptation. Nature Climate Change, 3(2), 112–117.

Agrawal, A. (2008). The role of local institutions in adaptation to climate change. World Bank Social Development Working Paper No. 113.

Ajibade, I. (2019). Planned retreat in global south megacities: Displacement, relocation and the climate justice gap. Progress in Human Geography, 43(3), 502–524.

Ajibade, I., McBean, G., & Bezner-Kerr, R. (2013). Urban flooding in Lagos, Nigeria: Patterns of vulnerability and resilience among women. Global Environmental Change, 23(6), 1714–1725.

Altieri, M. A., & Nicholls, C. I. (2017). The adaptation and mitigation potential of traditional farming systems. In the literature on agroecological resilience and climate adaptation.

Anugwom, K. N., & Anugwom, E. E. (2022). Climate change and community resilience in Nigeria: The role of grassroots institutions. Journal of Environmental Management, 313, 114954.

Ayanlade, A., Radeny, M., & Morton, J. F. (2018). Comparing smallholder farmers' perception of climate change with meteorological data: A case study from southwestern Nigeria. Weather and Climate Extremes, 15, 24–33.

Berkes, F. (2017). Environmental governance for the Anthropocene? Social-ecological systems, resilience, and collaborative learning. Sustainability, 9(7), 1232.

Choko, K., Eze, B. E., & Ume, S. I. (2019). Community-based adaptation and climate change governance in Nigeria: Lessons from grassroots experiences. Climate and Development, 11(6), 509–519.

Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research. SAGE.

Dixit, A., et al. (2012). Floods and vulnerability: Need to rethink flood management. Natural Hazards, 61(1), 1–5.

Douglas, I., Alam, K., Maghenda, M., McDonnell, Y., McLean, L., & Campbell, J. (2008). Unjust waters: Climate change, flooding and the urban poor in Africa. Environment and Urbanization, 20(1), 187–205.

Ebele, N. E., & Emodi, N. V. (2016). Climate change and its impact in Nigerian economy. Journal of Scientific Research and Reports, 10(6), 1–13.

Ekong, E. E., & Abang, S. O. (2020). Traditional institutions and climate change adaptation: Evidence from flood-prone communities in southern Nigeria. International Journal of Climate Change Strategies and Management, 12(4), 471–488.

Etounovbe, A. K. (2019). Flooding and climate change adaptation in Nigeria: The missing link of indigenous knowledge. Journal of Environmental Geography, 12(3–4), 23–34.

Ford, R., Ojha, H. R., Keenan, R. J., Race, D., Vega, D. C., Baral, H., & Sapkota, P. (2016). Delocalizing communities: Changing forms of community engagement in natural resources governance. World Development, 87, 274–290.

Holling, C. S. (1973). Resilience and stability of ecological systems. Annual Review of Ecology and Systematics, 4, 1–23.

Huq, S., Reid, H., & Murray, L. A. (2007). Climate change and development links. Gatekeeper Series, IIED.

Ifejika Speranza, C. (2010). Resilient adaptation to climate change in African agriculture. African Journal of Environmental Science and Technology, 4(13), 873–884.

Intergovernmental Panel on Climate Change. (2014). Climate change 2014: Impacts, adaptation, and vulnerability. Cambridge University Press.

Intergovernmental Panel on Climate Change. (2022). Climate change 2022: Impacts, adaptation and vulnerability. Cambridge University Press.

Naess, L. O. (2013). The role of local knowledge in adaptation to climate change. Wiley Interdisciplinary Reviews: Climate Change, 4(2), 99–106.

Nyong, A., Adesina, F., & Elasha, B. O. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in Africa. Mitigation and Adaptation Strategies for Global Change, 12(5), 787–797.

Oladokun, V. O., & Proverbs, D. G. (2018). Flood risk management in Nigeria. Natural Hazards, 83(3), 1793–1817.

Orlove, B., Roncoli, C., Kabugo, M., & Majugu, A. (2010). Indigenous climate knowledge in southern Uganda: The multiple components of a dynamic regional system. Climatic Change, 100(2), 243–265.

Ozor, N., & Nnaji, C. (2020). The role of extension in agricultural adaptation to climate change. Journal of Agricultural Extension and Rural Development, 3(3), 42–50.

Pretty, J. (2003). Social capital and the collective management of resources. Science, 302, 1912–1914.

UNDP. (2021). Human development report 2021. United Nations Development Programme.

Walker, B., & Folke, C. (2004). Exploring resilience in social-ecological systems. Comparative studies and theory development.

Warren, D. M. (1980). Indigenous knowledge systems and development. UNESCO.

Adesina, F., & Elasha, O. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in Africa. Mitigation and Adaptation Strategies for Global Change, 12(5).

Ayanlade, A., & Jegede, P. (2021). Climate change adaptation options in farming communities.

Fasona, M. J., & Omojola, A. S. (2020). Climate change adaptation and resilience building through indigenous knowledge in Nigeria. African Geographical Review, 39(1), 1–15.

Ikeke, M. O. (2021). Indigenous knowledge and environmental sustainability in Nigeria. Journal of Sustainable Development in Africa, 15(3), 32–45.

Nkiaka, E., Taylor, A., Dougill, A. J., Antwi-Agyei, P., & Belay, A. (2019). Identifying user needs for weather and climate services to enhance resilience to climate shocks in sub-Saharan Africa. Environmental Research Letters, 14(12), 123003.

Nkiwane, S., Nyanga, P. H., & Moyo, D. (2021). Enhancing climate adaptation through integration of indigenous and scientific knowledge systems. Climate and Development, 11(8), 659–668.

Nyadzi, E., Werners, S., & van Slobbe, E. (2021). What is the role of local knowledge in climate change adaptation? Climate and Development.

Saleemul Huq, H., & Schipper, L. (2014). Community-based adaptation theory and practice.

United Nations Development Programme. (2021). Human development report 2021. UNDP.