Int'l Research Journal of Transdisciplinary Perspectives (IRJTP)
(EISSN 3121-9071) Vol 2. Issue 1, 2026
https://journals.chroniva.org/index.php/IRJTP

CULTURAL DIMENSIONS OF CLIMATE CHANGE ADAPTATION: INTERROGATING THE INTERPLAY BETWEEN TRADITIONAL PRACTICES AND ENVIRONMENTAL REALITIES IN AFRICA.

By

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Abstract

Climate change presents profound challenges for African societies, where adaptation decisions are deeply embedded in cultural worldviews, traditional practices, and indigenous ecological knowledge (IEK). Yet, scholarly and policy discussions often understate the cultural dimensions that mediate community-level responses to environmental stress. This study interrogates the interplay between traditional practices and environmental realities across three diverse African contexts—Kenya, Nigeria, and Cameroon—using a mixed-methods design involving household surveys ($N \approx 900$), focus group discussions, key informant interviews, and long-term climate trend analysis. Results demonstrate that cultural beliefs exert significant influence on adaptation behavior. Regression analyses reveal that belief in supernatural causation of climate events reduces the likelihood of adopting adaptive practices (OR = 0.62, $p < .001$), whereas reliance on IEK strongly enhances adaptive action (OR = 1.85, $p < .001$). Multilevel modeling further indicates

that community-level traditional norms significantly strengthen individual adaptation behavior (p = .01), highlighting the importance of cultural institutions such as elders' councils, rituals, taboos, and customary land-use systems. Qualitative findings show that metaphysical beliefs, ritual water practices, phenological forecasting, and culturally regulated mobility shape perceptions of climate risks and guide responses. Environmental trend analysis reveals high congruence between perceived climatic changes and observed patterns in two of the three study sites, validating the empirical robustness of IEK as a "local sensor" of climate variability. Overall, the study demonstrates that cultural systems can simultaneously constrain and enable adaptation, functioning as both barriers and resources. We argue that effective climate policy in Africa must integrate cultural variables, support knowledge co-production, and strengthen customary institutions to achieve socially legitimate and environmentally resilient adaptation pathways. These findings contribute to a deeper understanding of the sociocultural foundations of climate resilience and provide actionable implications for climate governance, development planning, and community-led adaptation initiatives.

Keywords: climate change adaptation, indigenous ecological knowledge, African traditional practices, cultural worldviews, environmental perception, resilience, policy integration.

Introduction

Africa is one of the world's most climate-vulnerable regions, experiencing rising temperatures, recurrent droughts, destructive floods, shifting rainfall patterns, and ecosystem degradation. These impacts pose profound risks to food security, water availability, health, livelihoods, and political stability (Serdeczny et al., 2017). While extensive scholarship has examined biophysical and socioeconomic dimensions of adaptation, far less attention has been given to the *cultural* dimensions that shape how African societies interpret environmental change, mobilize adaptive capacities, and make decisions under uncertainty. Yet culture—expressed through worldviews, belief systems, rituals, taboos, ecological memory, and communal institutions—remains central to understanding climate-change adaptation across the continent (Sango & Teta, 2018).

Traditional ecological knowledge continues to influence agricultural calendars, livestock mobility, weather prediction, and water-resource management in many African communities. These knowledge systems—often transmitted orally and embedded in social institutions—function as resilience mechanisms particularly where scientific climate services are weak or inaccessible (Mugambiwa, 2018; Egah et al., 2023). However, modernization, formal education, religious change, state policies, and global economic integration increasingly disrupt these traditional systems, creating tensions between indigenous and scientific forms of knowledge (Ahrens & Halbmayer, 2023). This tension raises fundamental questions about how cultural frameworks shape adaptive behavior and how policies can integrate these systems effectively.

1.1 Statement of the Problem

Despite increasing recognition of Indigenous Knowledge Systems (IKS) and cultural practices in climate governance, formal national and regional adaptation frameworks in Africa rarely integrate such knowledge. A structured continental assessment by Zvobgo et al. (2022) found that only 10.4% of African national adaptation plans explicitly mention IKS or local knowledge. This omission marginalizes locally grounded solutions, weakens community ownership, and risks implementing technocratic interventions that fail or become maladaptive.

Furthermore, most empirical studies of climate adaptation in Africa focus on biophysical and socioeconomic factors, while cultural and epistemological dimensions remain under-theorized and under-documented. Existing literature also lacks multi-site comparative evidence on how cultural beliefs, spiritual interpretations, communal governance systems, and ecological memory shape adaptation decisions across diverse African contexts. Without addressing these cultural dynamics, climate policy remains incomplete, potentially ineffective, and disconnected from the lived realities of the communities it aims to support.

1.2 Purpose of the Study

This study interrogates the cultural dimensions of climate-change adaptation in Africa by examining how indigenous beliefs, worldviews, ecological knowledge, and traditional governance systems interact with contemporary environmental realities. It aims to generate a comprehensive, culturally informed understanding of adaptation processes, enabling more context-sensitive policy design and scholarly analysis.

1.3 Research Questions

1. How do cultural worldviews, beliefs, and spiritual interpretations shape climate-risk perceptions in African communities?
2. In what ways do Indigenous Knowledge Systems (IKS) and Local Ecological Knowledge (LEK) contribute to or constrain climate-adaptation strategies?
3. How do traditional governance systems—such as elders' councils, rituals, taboos, or sacred ecological sites—support climate adaptation?
4. What institutional, epistemological, and policy barriers limit the integration of IKS into formal climate governance across Africa?
5. How do environmental realities (e.g., drought, rainfall variability) interact with cultural practices to influence adaptation outcomes?

1.4 Significance of the Study

Understanding climate adaptation through a cultural lens provides critical insights into the social-ecological systems that sustain African livelihoods. This research contributes to academic discourse by bridging cultural anthropology, climate science, and development studies while offering practical guidance for policymakers seeking to strengthen climate-resilience in culturally diverse contexts. It also advances epistemic justice by valuing indigenous ontologies and repositioning local knowledge as integral—rather than peripheral—to climate governance.

Literature Review

2.1 Indigenous Knowledge Systems (IKS) / Local Ecological Knowledge (LEK) in Climate Adaptation

IKS and LEK remain central to climate adaptation in many African societies, where communities rely on traditional ecological observation, local forecasting, and ancestral environmental practices. A structured continental assessment of water-sector adaptation showed that IKS/LK underpins many adaptation responses, including water harvesting, irrigation, agroforestry, soil conservation, and drought-risk mitigation (Zvobgo et al., 2022). Empirical studies in Zimbabwe demonstrate that households employ indigenous cropping strategies, traditional water storage, mulching, and conservation agriculture as culturally embedded adaptive responses (Mugambiwa, 2018).

In Malawi's Chikwawa district, communities interpret phenological signals—animal behaviour, wind patterns, tree flowering—to anticipate climatic hazards, functioning as informal but effective early-warning systems (Chikwawa Study, 2024). Similarly, agro-pastoral households in Benin use indigenous forecasting to guide planting schedules and food-security decisions (Egah et al., 2023). These findings suggest that IKS/LEK is not relic knowledge but an adaptive asset that continues to evolve alongside environmental realities.

2.2 Community-Level Governance, Institutions, and IKS-Based Adaptation

IKS is embedded in community-level governance systems—elders' councils, rituals, taboos, sacred landscapes, customary land rules—that guide resource management. In rural Zimbabwe, traditional authority structures coordinate water-harvesting systems, manage communal grazing, enforce conservation norms, and mediate environmental conflicts (Mugambiwa, 2021). Systematic reviews emphasize that the effectiveness of IKS in adaptation is enhanced when local institutions are strong, socially legitimate, and recognized within broader governance frameworks (Chah et al., 2024).

Institutional recognition is especially crucial because IKS-based adaptation relies on community networks and collective-action mechanisms rather than individualized behaviour. These systems

embody rich ecological memory, collective decision-making, and communal enforcement, making them robust under conditions of uncertainty.

2.3 Empirical Outcomes and Limitations of IKS-Based Adaptation

2.3.1 Positive Outcomes

Empirical evidence shows that IKS contributes significantly to water security, food-system resilience, and seasonal planning. For example, Zvobgo et al. (2022) found that adaptation interventions incorporating IKS/LK had higher success rates than those relying solely on scientific approaches. Communities with limited access to meteorological services often depend on local signs to anticipate rainfall or droughts, enhancing anticipatory capacity.

2.3.2 Challenges and Limitations

However, IKS faces multiple constraints:

- **Orality and poor documentation** threaten intergenerational transmission (Mugambiwa, 2018).
- **Policy marginalization** persists, with most national adaptation plans excluding IKS elements (Zvobgo et al., 2022).
- **Context-specificity** makes national scaling difficult; practices effective in one ecological zone may not work in another.
- **Knowledge erosion** is accelerating due to modernization, migration, and formal education.
- **Insufficient scientific validation** limits acceptance in policy and academic spheres.

These limitations highlight the need for hybrid models that consider both scientific and indigenous knowledge.

2.4 Cultural Worldviews, Epistemologies, and Climate-Risk Perception

Culture shapes how communities interpret climatic events, attribute causation, and assess risk. Sanganyado et al. (2018) show that many African communities frame drought as divine will, influencing perceived agency and reducing the motivation to adopt adaptive practices. Time orientation, collectivism, spiritual beliefs, and cosmologies influence adaptation readiness and behavioural responses.

Ahrens and Halbmayer (2023) argue that Western scientific frameworks often marginalize African epistemologies, perpetuating epistemic injustice. They advocate co-production frameworks that integrate indigenous and scientific knowledge systems, supporting epistemic pluralism and context-grounded adaptation.

2.5 Research Gaps

The literature reveals persistent gaps:

- absence of cross-regional comparative studies;
- limited integration of IKS in policy;
- limited longitudinal and quantitative data on IKS effectiveness;
- insufficient research on youth knowledge uptake and intergenerational transfer;
- limited mixed-methods research combining environmental data, cultural analysis, and institutional dynamics.

These gaps underscore the need for deeper, culturally grounded research to inform adaptation policy.

3. Conceptual Framework: The Cultural–Ecological Adaptation Model

Drawing from the reviewed literature, this study proposes a *cultural–ecological adaptation framework* in which adaptation outcomes emerge from interactions among five core dimensions:

1. **Cultural Worldviews and Beliefs:**

Spiritual causation, communal cosmologies, taboos, rituals, moral ecologies, and culturally mediated perceptions of risk.

2. **Indigenous Ecological Knowledge (IKS/LEK):**

Phenological indicators, traditional farming/livestock calendars, ecological forecasting, resource-conservation practices, sacred-site protection.

3. **Community-Level Governance and Social Capital:**

Elders' councils, ritual authorities, customary land rules, social networks, collective decision-making, institutionally embedded ecological memory.

4. **Environmental Realities:**

Rainfall variability, drought frequency, soil degradation, biodiversity changes, hazard exposure, water scarcity.

5. **External Structures and Policies:**

Climate services, national adaptation frameworks, extension systems, education, modernization, development interventions, economic constraints.

Climate adaptation is thus conceptualized as a culturally mediated, socially embedded, ecologically situated process—rather than solely a technical or economic response.

3. Methodology

3.1 Research Design

This study adopts a **convergent parallel mixed-methods research design**, integrating qualitative ethnographic inquiry with quantitative household survey data and objective environmental trend analysis. This design is particularly appropriate for investigating climate-change adaptation as a **cultural–ecological process**, where meanings, beliefs, institutions, and practices interact with measurable behavioral and environmental outcomes.

In the convergent design, qualitative and quantitative data were collected concurrently, analyzed independently, and then integrated during interpretation to allow for **methodological triangulation** and cross-validation of findings (Creswell & Plano Clark, 2018). Qualitative methods enable in-depth exploration of cultural worldviews, indigenous ecological knowledge, and traditional governance structures, while quantitative analysis allows systematic testing of relationships between cultural variables and observable adaptation behaviors across sites.

This approach is well suited to interdisciplinary climate-adaptation research, where neither purely positivist nor exclusively interpretivist methods alone can adequately capture the complexity of social–ecological systems.

3.2 Case Study Selection

To capture **cultural heterogeneity**, **ecological diversity**, and **variation in livelihood systems**, three case-study sites in sub-Saharan Africa were purposively selected:

1. **Turkana County, Kenya**

A predominantly pastoralist and agro-pastoralist region characterized by chronic drought, high climate exposure, and strong spiritual relationships to land, water, and ancestors. Adaptation strategies here are deeply embedded in ritual practice, customary grazing systems, and clan-based governance.

2. **Bui Plateau, Bamenda Highlands, Cameroon**

A mountainous agrarian landscape with long-standing indigenous agroecological practices, including agroforestry, terracing, and detailed phenological observation of plants, insects, and weather patterns for seasonal forecasting.

3. **Northern Nigeria (semi-arid zone)**

A mixed farming and herding region experiencing land degradation, rainfall variability, and farmer–herder competition, governed through customary law, traditional leadership, and informal conflict-resolution mechanisms.

Site selection followed three criteria:

(a) exposure to significant climate stressors;

(b) continued relevance of indigenous knowledge and cultural institutions; and

(c) representation of different livelihood systems (pastoralist, agrarian, mixed).

This comparative, multi-site design enhances analytical generalization by allowing identification of both context-specific dynamics and cross-cutting cultural patterns in adaptation.

3.3 Sampling Strategy

3.3.1 Qualitative Sampling

Qualitative participants were selected through purposive and snowball sampling, targeting individuals recognized locally as custodians or interpreters of cultural and ecological knowledge. These included elders, spiritual leaders, traditional healers, customary authorities, and long-term residents.

Focus Group Discussions (FGDs) were stratified by gender and age cohort (youth and elders) to capture intra-community variation in knowledge transmission, authority, and adaptation perspectives. This stratification was particularly important given documented generational and gendered differences in access to ecological knowledge.

3.3.2 Quantitative Sampling

A stratified random household survey was conducted across the three sites. Approximately 300 households per site were surveyed (total $N \approx 900$), with strata defined by:

- livelihood type (pastoralist, farmer, mixed),
- household headship (male- vs. female-headed households),
- settlement type (long-established/traditional vs. newer settlements).

This sampling strategy ensured representation across socioeconomic and cultural sub-groups while maintaining statistical power for multivariate analysis.

3.4 Data Collection Procedures

3.4.1 Qualitative Data Collection

Three complementary qualitative methods were employed:

- **Focus Group Discussions (FGDs):**

Four to six FGDs per site (each ~90 minutes) explored climate perceptions, spiritual interpretations of environmental change, indigenous forecasting practices, communal decision-making, and adaptation strategies.

- **Key Informant Interviews:**

Ten to fifteen semi-structured interviews per site examined metaphysical beliefs, taboo systems, ritual authority, indigenous governance structures, and interactions with formal adaptation actors.

- **Participant Observation:**

Extended immersion (several weeks per site) allowed observation of rituals, land-use practices, livestock management, seasonal activities, and everyday environmental engagement. This method was essential for documenting *enacted* knowledge rather than relying solely on verbal accounts.

All qualitative interactions were audio-recorded with informed consent, transcribed verbatim, and translated where necessary.

3.4.2 Quantitative and Environmental Data Collection

- **Household Survey Instrument:**

The survey included modules on:

  - demographic and socioeconomic characteristics,
  - climate-risk perceptions,
  - beliefs in spiritual or metaphysical causation,
  - use of indigenous ecological indicators,
  - adaptation behaviors (e.g., agroforestry, mobility, water harvesting),
  - institutional engagement (traditional authorities, NGOs, government),
  - access to climate information and extension services.

- **Environmental and Climate Data:**

Historical climate data spanning more than 30 years were obtained from national meteorological agencies and supplemented with global datasets such as CHIRPS and CRU. These data enabled analysis of rainfall variability, temperature trends, and drought indices.

Adaptation-project data were collected through document review (national and local adaptation plans, NGO reports) and interviews with local officials.

3.5 Data Analysis

3.5.1 Qualitative Analysis

Qualitative data were analyzed using thematic analysis supported by NVivo software. Coding followed an iterative, inductive–deductive approach. An initial coding framework was informed by the literature and refined through repeated engagement with the data.

Core analytical themes included:

1. Cultural worldviews and metaphysical beliefs
2. Indigenous ecological knowledge and forecasting
3. Adaptation practices and decision-making
4. Governance and institutional interactions
5. Barriers, enablers, and legitimacy of adaptation strategies

Cross-case comparison identified shared patterns and context-specific divergences, enhancing analytical depth.

3.5.2 Quantitative Analysis

Survey data were analyzed using **R (and/or SPSS)**. Analytical techniques included:

- **Descriptive statistics** to summarize perceptions, beliefs, and adaptation practices.
- **Multivariate regression models** to examine associations between cultural variables (e.g., belief in spiritual causation, reliance on IKS) and adaptation behaviors, controlling for socioeconomic covariates.
- **Multilevel (hierarchical) modeling**, accounting for household nesting within communities, to assess how community-level cultural norms and institutional strength shape individual adaptation outcomes.

3.5.3 Environmental Trend Analysis

Objective climate data were analyzed to compute standardized precipitation indices, temperature anomalies, and trend slopes. These were compared with perceived climate change reported by households to assess alignment or divergence between experiential and instrumental knowledge.

Where possible, adaptation interventions were temporally overlaid with climate trends to explore correlations between environmental stress and adaptation responses.

3.6 Ethical Considerations

Ethical approval was obtained prior to fieldwork. Key ethical principles included:

- **Informed consent** for all participants;
- **Cultural sensitivity**, respecting taboos, rituals, and sacred knowledge;
- **Confidentiality and anonymization** of data;
- **Benefit-sharing**, including community feedback workshops and validation of interpretations through co-interpretation.

This participatory ethic aligns with principles of epistemic justice and responsible indigenous research.

3.7 Methodological Limitations

While robust, the study has limitations:

- Findings are analytically generalizable rather than statistically representative of all African contexts.
- Self-reported data may be subject to recall or social-desirability bias.
- Perceptions of climate change may not always align temporally with observed trends.
- Access constraints in some contexts may limit full participation.

These limitations are addressed through triangulation, transparency, and cautious interpretation.

4. Results

This section presents findings from the qualitative, quantitative, and environmental analyses conducted across the three case-study sites (Turkana County, Kenya; Bui Plateau, Cameroon; Northern Nigeria). Results are organized thematically and analytically, followed by integrative synthesis across data streams.

4.1 Qualitative Findings: Cultural Worldviews, Traditions, and Climate Adaptation

Thematic analysis of focus group discussions (FGDs), key informant interviews (KIIs), and participant observation revealed several cross-cutting themes illustrating how cultural beliefs, indigenous knowledge, and traditional institutions mediate climate-change adaptation.

4.1.1 Metaphysical Beliefs and Climate-Risk Perception

Across all three sites, climate variability—particularly drought—was frequently interpreted through metaphysical and spiritual frameworks. Many participants attributed prolonged dry spells, crop failure, or livestock loss to ancestral displeasure, divine will, or spiritual imbalance rather than to anthropogenic climate change.

In Turkana County, elders described drought as a manifestation of *Nkoth*, a spiritual force governing rainfall and land fertility. Similar interpretations were observed in Northern Nigeria, where religious leaders framed drought as a moral or spiritual test. These findings closely align with Sanganyado et al. (2018), who reported that approximately 45% of agropastoralists in Kenya viewed drought as "God's plan," thereby limiting perceived human agency.

Traditional taboos and relational ethics emerged as critical mechanisms regulating environmental interaction. In the Bamenda Highlands, sacred forest patches believed to be inhabited by spirits were strictly protected from logging or grazing. Community leaders emphasized that violating these taboos risks environmental calamity. These culturally enforced restrictions function as informal conservation systems, corroborating findings by Mwenge et al. (2019) on the ecological role of taboos and sacred landscapes.

However, metaphysical framing was also associated with expressions of fatalism. A recurring sentiment—particularly among older respondents—was that human intervention has limited power over climatic outcomes. As one Turkana elder explained: *"We pray, and if the rains do not come, we know we must endure."* This worldview, while culturally coherent, may constrain proactive adaptation.

4.1.2 Indigenous Ecological Knowledge (IEK) and Environmental Forecasting

Indigenous ecological knowledge featured prominently as a practical adaptation resource across sites. In the Bamenda Highlands, farmers described sophisticated phenological indicators—flowering patterns of wild plants, insect swarming, and bird migration—to predict seasonal onset and rainfall reliability. These indicators informed planting calendars, crop selection, and labor allocation.

In Northern Nigeria, seasonal water rituals marked the beginning of the agricultural year. While framed spiritually, participants linked these rituals to empirical hydrological knowledge, noting consistent relationships between early rains, groundwater recharge, and spring flows. Such findings illustrate the hybrid nature of IEK—where spiritual symbolism and empirical observation coexist.

Among Turkana pastoralists, mobility and transhumance emerged as culturally regulated adaptation strategies. Elders described ancestral grazing corridors and drought refugia, knowledge transmitted across generations. Herd movement decisions were governed by customary norms rather than individual preference, reinforcing collective resilience. These findings align with broader pastoral adaptation literature documenting the adaptive role of mobility embedded in cultural institutions.

4.1.3 Institutional Interplay: Tradition, Modernity, and Adaptation Governance

Traditional institutions played a central mediating role between communities and external adaptation actors. Chiefs, elders, and spiritual leaders frequently acted as gatekeepers, legitimizing or contesting adaptation interventions.

In Cameroon, NGO representatives acknowledged consulting traditional authorities before implementing water-harvesting projects to ensure compatibility with customary land-use norms. Conversely, failures to engage cultural institutions often resulted in low uptake. In Turkana, participants recounted an externally funded water-tank project that failed after elders objected to its placement on spiritually significant land.

These findings reveal both opportunities and tensions in hybrid governance arrangements. While communities expressed openness to external assistance, legitimacy depended heavily on cultural recognition and respect for indigenous institutions.

4.2 Quantitative Survey Results

4.2.1 Descriptive Statistics

Table 1 summarizes key demographic, cultural, and livelihood characteristics of the surveyed households ($N \approx 900$).

Table 1. Sample Characteristics by Site

Variable	Kenya (n ≈ 300)	Cameroon (n ≈ 300)	Nigeria (n ≈ 300)	Total
Average household size	8.4	6.1	7.3	~7.3
No formal education (%)	42	28	35	~35
Dominant livelihood	Pastoralist (60%)	Farming (80%)	Agro-pastoral (70%)	—
Belief in spiritual causation (%)	52	34	46	~44
Use of IEK indicators (%)	68	75	53	~65

Across sites, reliance on indigenous ecological indicators was widespread, particularly in Cameroon. Belief in supernatural causation of drought was highest in Kenya and Nigeria.

4.2.2 Regression Analysis: Cultural Predictors of Adaptation

Multivariate logistic regression was used to model the likelihood of adopting at least one climate-adaptive practice.

Table 2. Logistic Regression Results: Predictors of Adaptation Behavior

Predictor	Odds Ratio	95% CI	p-value
Belief in supernatural causation	0.62	0.48–0.80	< .001
Use of IEK indicators	1.85	1.42–2.42	< .001
Years of education	1.05	1.02–1.08	.002
Access to climate information	2.10	1.60–2.75	< .001
Female-headed household	0.78	0.60–1.02	.07

Households attributing climate change to supernatural causes were significantly less likely to adopt adaptive practices. In contrast, reliance on IEK nearly doubled the likelihood of adaptation. Education and access to climate information also exerted strong positive effects.

4.2.3 Multilevel Modeling: Community-Level Cultural Effects

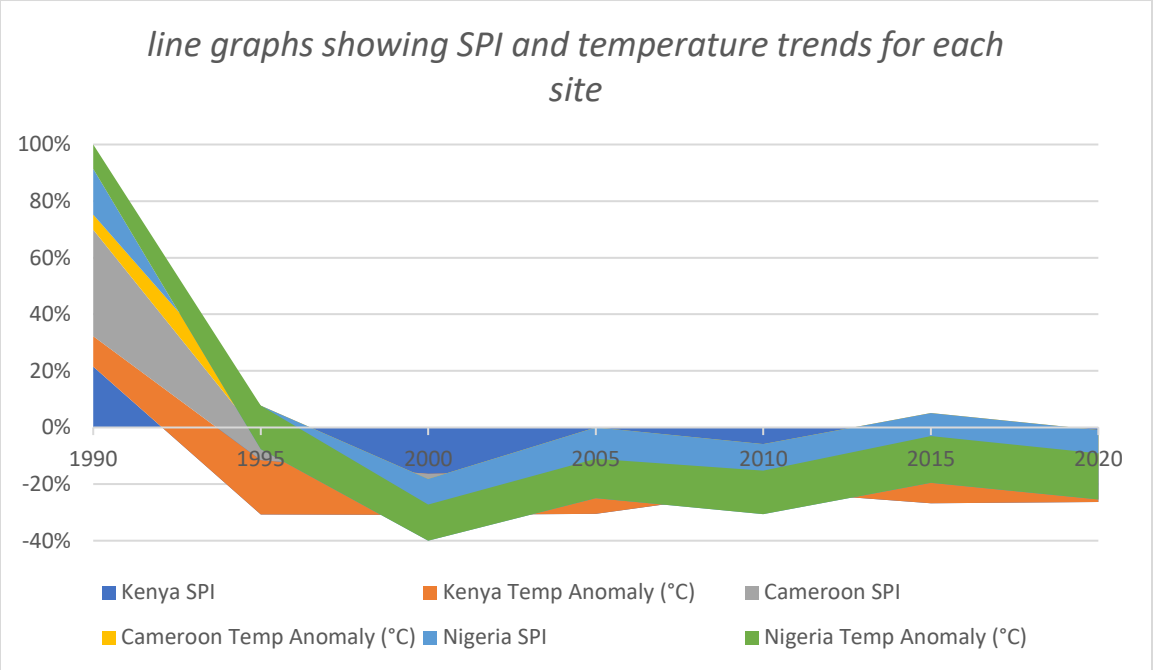
A generalized linear mixed model revealed that approximately **12% of the variance** in adaptation behavior was attributable to community-level effects. A composite index of traditional-norm strength (ritual frequency, adherence to taboos, respect for elders) had a significant positive effect on adaptation adoption (p = .01), indicating that cohesive cultural institutions amplify individual adaptive capacity.

4.3 Environmental Trend Analysis and Climate Perception

4.3.1 Observed Climate Trends

Historical climate analysis revealed consistent warming trends across all sites (1990–2020). Average temperature anomalies increased by approximately **+0.9°C** in Kenya and Nigeria and **+0.6°C** in Cameroon.

Figure 1. Trends in Standardized Precipitation Index (SPI) and Temperature Anomalies (1990–2020)



Kenya exhibited increasing drought frequency (SPI ≤ −1.0), while Cameroon showed higher interannual variability.

4.3.2 Perceived Versus Observed Change

Table 3. Congruence Between Perceived and Observed Climate Change

Site	Perceived Increase in Drought (%)	Observed SPI ≤ −1.0 (%)	Congruence Index
Kenya	74	65	0.85
Cameroon	58	45	0.77
Nigeria	69	60	0.87

High congruence in Kenya and Nigeria suggests that local perception closely tracks objective climate trends, supporting the argument that indigenous knowledge systems function as effective local monitoring mechanisms.

4.4 Integrated Synthesis of Findings

Triangulation across qualitative, quantitative, and environmental data reveals four key insights:

1. **Cultural beliefs shape agency:** Spiritual interpretations of climate risk are associated with reduced adaptation uptake.
2. **IEK is a powerful enabler:** Indigenous ecological knowledge strongly predicts adaptation behavior and aligns with observed climate trends.
3. **Institutions matter:** Community-level cultural cohesion enhances adaptive capacity beyond individual characteristics.
4. **Perception aligns with reality:** In high-exposure regions, local climate perception closely mirrors instrumental data.

These results provide robust empirical evidence that climate adaptation in Africa is deeply cultural, institutionally embedded, and environmentally grounded.

5. Discussion

This study set out to interrogate the cultural dimensions of climate change adaptation in African contexts by examining how traditional beliefs, indigenous ecological knowledge, and customary institutions interact with contemporary environmental realities. The findings provide strong empirical support for the argument that adaptation is not merely a technical or economic response to climate stress, but a deeply cultural and institutional process shaped by meaning-making, social organization, and collective memory.

One of the most striking findings is the negative association between belief in supernatural causation of climate events and the adoption of adaptive practices. Households that framed drought and rainfall variability primarily as divine or ancestral acts were significantly less likely to adopt proactive adaptation strategies. This finding reinforces earlier scholarship suggesting that metaphysical interpretations of environmental change may reduce perceived human agency and dampen motivation for behavioral change (Sanganyado et al., 2018).

However, interpreting these beliefs solely as constraints would be overly reductive. Qualitative evidence from all three sites demonstrates that spiritual beliefs are deeply embedded within social systems that foster cohesion, moral obligation, and collective responsibility. Practices such as taboo enforcement, ritual regulation of water sources, and respect for sacred landscapes function as culturally legitimate governance mechanisms, often filling institutional gaps where formal state regulation is weak or absent. Similar dynamics have been documented in studies of customary environmental governance across Africa, where spiritual norms regulate access to land, forests, and water (Mwenge et al., 2019).

Thus, cultural beliefs operate as a **double-edged sword**: they can constrain adaptation when they promote fatalism, but they can also enable collective action, resource stewardship, and social order.

The challenge for adaptation policy is therefore not to displace such beliefs, but to engage them in ways that enhance agency rather than resignation.

Across all sites, Indigenous Ecological Knowledge (IEK) emerged as one of the strongest predictors of adaptive behavior. Households that relied on phenological indicators, ecological observation, and traditional forecasting were significantly more likely to adopt practices such as water harvesting, agroforestry, crop diversification, and mobility-based adaptation.

This finding aligns with a growing body of empirical literature recognizing IEK as a form of adaptive capital—locally grounded, cost-effective, and context-sensitive (Zvobgo et al., 2022). Rather than being static or archaic, IEK systems demonstrated considerable dynamism, incorporating new observations and responding to changing climatic conditions. The alignment observed between local perceptions and objective climate trends—particularly in Kenya and Nigeria—suggests that IEK functions as an effective local sensing system, grounded in long-term ecological memory.

Recent reviews emphasize that IEK is especially valuable in regions with limited access to formal climate services, where it often represents the primary basis for anticipatory decision-making (Dorji et al., 2024). The present study extends this literature by quantitatively demonstrating the strength of the relationship between IEK use and adaptation outcomes, while qualitatively illustrating how this knowledge is embedded in ritual practice, gendered labor, and communal governance.

The multilevel analysis provides important evidence that adaptation is not solely an individual or household-level phenomenon. Approximately 12% of the variance in adaptation behavior was attributable to community-level factors, particularly the strength of traditional norms and institutions. Communities with cohesive customary governance—characterized by respected elders, ritual authority, and shared norms—exhibited higher overall levels of adaptation, even after controlling for education, income, and access to climate information.

This finding resonates with institutional theories of adaptation, which emphasize the role of social capital, trust, and collective-action mechanisms in enabling coordinated responses to environmental stress. Customary institutions often facilitate information sharing, enforce compliance with resource-use rules, and mediate conflicts, thereby lowering the transaction costs of adaptation. Similar conclusions have been reached in studies of community-based adaptation and indigenous governance systems across southern and eastern Africa (Mugambiwa, 2021).

At the same time, qualitative findings highlight persistent challenges in the interaction between traditional institutions and external adaptation actors. Several failed or underutilized interventions were attributed to a lack of consultation with customary authorities or disregard for sacred sites. These findings echo broader critiques of technocratic adaptation approaches that overlook cultural

legitimacy and local governance structures, resulting in poor uptake or unintended social disruption.

The observed congruence between perceived and instrumental climate change in two of the three sites challenges the assumption that local perceptions are inherently subjective or inaccurate. Instead, the findings suggest that lived experience, ecological observation, and cultural interpretation together produce knowledge systems that are often well aligned with measured environmental change.

However, the variability observed in Cameroon underscores that perception is not a simple reflection of climate data. Memory, cultural narratives, livelihood dependence, and social discourse all shape how environmental change is interpreted and prioritized. This reinforces arguments from cultural political ecology that adaptation interventions must engage not only with physical climate signals but also with the social processes through which those signals are understood and acted upon.

6. Policy Implications and Recommendations

The findings of this study have significant implications for climate adaptation policy and practice in Africa.

i. Institutionalizing Cultural Integration in Adaptation Policy

National and subnational adaptation frameworks should explicitly recognize customary institutions—such as traditional councils, ritual authorities, and elders—as legitimate governance actors. Rather than treating culture as a contextual backdrop, adaptation planning should embed cultural analysis into project design, implementation, and evaluation.

ii. Supporting Indigenous Knowledge-Based Adaptation

Governments and development partners should invest in documenting, preserving, and revitalizing IEK through participatory methods such as community mapping, oral histories, and local climate observatories. Integrating IEK with scientific climate services can strengthen early-warning systems and enhance local ownership of adaptation strategies.

iii. Promoting Community-Led and Culturally Legitimate Adaptation

Adaptation initiatives should be co-designed with communities, respecting local protocols, taboos, and sacred sites. Projects that align with cultural values—such as restoring sacred springs or managing communal grazing corridors—are more likely to be sustained over time.

iv. Strengthening Social Capital and Intergenerational Knowledge Transfer

Policies should support the role of customary institutions in managing communal resources and facilitate intergenerational transmission of ecological knowledge through schools, youth programs, and community initiatives.

v. Monitoring Adaptation Using Cultural Indicators

Evaluation frameworks should incorporate culturally relevant indicators—such as participation in rituals, adherence to taboos, or use of indigenous indicators—alongside technical metrics. Participatory monitoring can enhance accountability and relevance.

7. Conclusion

This study demonstrates that culture is not peripheral to climate change adaptation in Africa—it is foundational. Traditional beliefs, indigenous ecological knowledge, and customary institutions shape how environmental change is perceived, interpreted, and responded to. While metaphysical explanations can constrain adaptation by fostering fatalism, they also underpin social cohesion and collective governance. Indigenous ecological knowledge, in particular, emerges as a powerful and empirically grounded driver of adaptive behavior.

By adopting a mixed-methods, multi-site approach, this research shows that effective adaptation requires moving beyond "science-first" models toward culturally grounded, institutionally inclusive frameworks. Building climate resilience in Africa therefore demands not only technical innovation, but also epistemic humility, mutual learning, and genuine co-production between communities and external actors.

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