Investigating Experiences of Local Communities on Adapting to Climate Change: A Case Study of Baroste Plains, Zambia

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ABSTRACT

Background: Climate change continues to threaten the environmental sustainability and socio-economic livelihoods of communities living in the Barotse Plains of Western Zambia, where livelihoods are heavily dependent on floodplain agriculture and fishing activities.

Aim: To investigate the experiences of local communities in adapting to climate change in the Barotse Plains, with particular focus on indigenous and modern adaptation strategies, challenges faced by communities, and community-driven approaches for strengthening climate resilience.

Methods: Guided by Cultural Theory, Adaptive Capacity Theory, and Utility Maximization Theory, the study employed a qualitative case study design involving two Focus Group Discussions (FGDs) and two Key Informant Interviews (KIIs) conducted in Senanga and Nalolo districts. Data were analysed thematically using Braun and Clarke's thematic analysis framework involving coding, theme generation, review, and interpretation of findings.

Findings: The findings revealed that community experiences of climate change adaptation are strongly influenced by recurrent floods and droughts, declining fish stocks, and unstable agricultural productivity. Key thematic areas identified include lived experiences of climate impacts, livelihood and survival strategies, institutional and socio-economic constraints, and evolving adaptation responses. The study shows that communities rely on a combination of indigenous and modern adaptation strategies. Indigenous practices include cultivation of drought-tolerant crops (cassava, sorghum, millet, squash, and sweet potatoes), animal collaring, traditional flood-based farming calendars, botanical and biological weather forecasting, use of grass and soil for household protection against floods, homemade agricultural tools, and gendered fishing techniques using traditional baskets and nets. Modern strategies involve improved maize seed varieties, synthetic fertilizers, conservation agriculture, tractor use, farmer field schools, canal maintenance, and small-scale irrigation schemes. However, the effectiveness of these strategies is constrained by multiple barriers, including inadequate irrigation infrastructure, high input costs, poor road accessibility during floods, weak institutional coordination, delayed agricultural inputs, limited access to climate information, depleted fish stocks, insufficient decentralised climate financing, and low community participation in climate governance. The study further highlights that strengthening integrated irrigation systems, fish restocking programmes, fisheries management committees, policy reforms under agricultural input support systems, documentation of indigenous knowledge, and decentralisation of climate adaptation financing are critical for enhancing community resilience.

Conclusion: The study concludes that effective climate adaptation within the Barotse Plains requires integrated and participatory approaches that combine indigenous knowledge systems with scientific innovation, decentralized governance, localized financing, and community-led planning structures. The study recommends the establishment of integrated climate adaptation systems that combine indigenous ecological knowledge with

scientific forecasting, alongside the decentralisation of adaptation policies to strengthen local participation in planning, implementation, and monitoring. It further recommends targeted agricultural and livelihood support in floodplain areas, including climate-resilient crops, irrigation technologies, livestock support, rural financing, and strengthened participatory governance through coordinated multi-stakeholder engagement.

Keywords: Climate Change Adaptation, Indigenous Knowledge Systems, Community Resilience, Floodplain Livelihoods, Barotse Plains, Climate-Smart Agriculture, Sustainable Development

BACKGROUND OF THE STUDY

Climate change has become one of the most critical environmental and socio-economic challenges affecting global development in the twenty-first century. Rising global temperatures, increased frequency of floods and droughts, prolonged heatwaves, and erratic rainfall patterns continue to threaten ecosystems, agricultural systems, food security, and human livelihoods across both developed and developing countries. According to the Intergovernmental Panel on Climate Change (IPCC, 2023), global temperatures have already increased by approximately 1.1°C above pre-industrial levels, contributing to severe environmental disruptions and increasing exposure of vulnerable populations to climate-related risks. The report further estimates that approximately 3.6 billion people currently live in highly climate-vulnerable settings, with developing countries facing disproportionately higher risks due to poverty, weak infrastructure, and limited adaptive capacity. Climate-induced disasters continue to intensify globally, with the United Nations Office for Disaster Risk Reduction (UNDRR, 2024) reporting that more than 185 million people were affected by climate-related disasters in 2023 alone. These disasters have contributed to rising levels of displacement, food insecurity, loss of livelihoods, and growing socio-economic inequalities.

Agriculture remains among the most climate-sensitive sectors globally, particularly in low-income countries where livelihoods depend heavily on rain-fed farming systems. The Food and Agriculture Organisation (FAO, 2023) projects that climate variability could reduce global crop yields by up to 30% by 2050 if adaptation measures are not strengthened. Changes in rainfall patterns, increased temperatures, and environmental degradation have already contributed to declining agricultural productivity, especially within vulnerable rural communities. Climate change therefore presents not only an environmental crisis but also a major development challenge with implications for poverty reduction, food systems, and rural sustainability.

Sub-Saharan Africa is considered one of the regions most vulnerable to climate change because of its high dependence on natural resources, weak institutional systems, and limited economic resilience. The African Development Bank (AfDB, 2024) estimates that climate change currently causes annual economic losses ranging between 5% and 15% of Gross Domestic Product across African economies through reduced agricultural productivity, infrastructure destruction, flooding, and disaster recovery costs. Furthermore, approximately 95% of agriculture in sub-Saharan Africa remains rain-fed, making rural livelihoods highly vulnerable to climate variability and environmental shocks (World Bank, 2023). Recent climate events across Southern Africa have demonstrated the increasing severity of environmental disruptions. Countries such as Zambia, Zimbabwe, Mozambique, and Malawi have experienced recurrent floods, prolonged droughts, declining crop productivity, and increasing household vulnerability (Sinyolo et al., 2022). These environmental shocks continue to undermine food security, weaken local economies, and intensify rural poverty among already vulnerable populations.

In Zambia, climate change has increasingly manifested through rising temperatures, erratic rainfall patterns, droughts, and recurrent flooding across different agro-ecological regions. The Ministry of Green Economy and Environment (2024) reports that Zambia's average temperatures have risen by approximately 1.3°C over the past century, while rainfall variability has significantly increased in recent decades. Climate-sensitive sectors such as agriculture, fisheries, livestock production, and water resources have experienced substantial disruptions, negatively affecting rural livelihoods and national food security. According to the Zambia Statistical Agency (ZamStats, 2024), more than 70% of Zambia's rural population depends directly on agriculture for survival, yet agricultural productivity continues to decline because of unpredictable climatic conditions. The World Bank (2023) further notes that Zambia's vulnerability to climate change is heightened by widespread poverty, inadequate rural infrastructure, weak extension systems, and limited access to climate adaptation technologies.

Consequently, rural communities increasingly face livelihood insecurity, reduced household incomes, and heightened exposure to environmental hazards.

The Barotse Plains in Western Zambia represent one of the country's most climate-sensitive ecological zones due to their exposure to recurrent flooding and seasonal environmental variability. The plains form part of the Zambezi floodplain system and support livelihoods primarily through subsistence farming, fishing, livestock rearing, and exploitation of natural resources. However, climate variability has increasingly disrupted these livelihood systems through intensified floods, prolonged dry spells, rising temperatures, and shifting rainfall patterns. Manda et al. (2024) observe that communities within Zambia's floodplain environments continue to experience severe climate vulnerability characterized by crop destruction, displacement of households, infrastructure damage, declining fish stocks, and increased food insecurity. Seasonal flooding within the Barotse Plains has become increasingly unpredictable, affecting access to markets, schools, healthcare services, and agricultural land. These environmental disruptions have significantly reduced livelihood stability among rural households and weakened community resilience.

Despite growing exposure to climate risks, local communities within flood-prone regions continue to develop and utilize both indigenous and modern adaptation strategies to sustain their livelihoods. Indigenous adaptation practices such as traditional weather forecasting, crop diversification, seasonal migration, mixed farming, canal construction, and adjustments in fishing practices remain important coping mechanisms among rural communities (Nyambe and Habenzu, 2022). Indigenous knowledge systems are often based on long-term environmental observations and community experiences that guide local responses to environmental changes. At the same time, governments and development agencies continue to promote modern adaptation interventions including conservation agriculture, irrigation technologies, climate-smart farming techniques, drought-resistant crop varieties, and early warning systems. Nevertheless, adoption of these strategies remains uneven due to financial constraints, weak institutional support, inadequate extension services, poor infrastructure, and limited access to climate information (Mulenga et al., 2023). Consequently, many vulnerable communities continue to face difficulties in effectively adapting to climate-induced environmental changes.

Community experiences and perceptions remain central to understanding climate adaptation processes because adaptation decisions are shaped by social realities, cultural beliefs, and local knowledge systems. Wang and Zhou (2020) argue that climate adaptation is socially constructed through lived experiences, historical interactions with the environment, and community interpretations of environmental risks. In many African rural contexts, communities rely not only on scientific climate information but also on indigenous ecological knowledge and culturally embedded practices when responding to environmental change. McNeeley (2021) further explains that local knowledge systems significantly influence adaptation behaviour, risk perception, and community resilience. This suggests that successful climate adaptation interventions must incorporate community experiences, socio-cultural realities, and indigenous perspectives rather than relying exclusively on externally designed technical solutions.

This study was guided by Cultural Theory, Adaptive Capacity Theory, and Utility Maximization Theory, which collectively provide a comprehensive understanding of climate adaptation behaviour among rural communities. Cultural Theory explains that environmental perceptions and responses are influenced by cultural values, social organisation, and collective worldviews (Douglas, 1992). Recent studies by Asenbaum et al. (2025) and Marlon et al. (2025) demonstrate that cultural orientations continue to shape climate risk perceptions and adaptation behaviour across societies. Adaptive Capacity Theory emphasizes that resilience to climate change depends on access to financial resources, institutional support, knowledge systems, infrastructure, and social networks (Janiszek and Krzysztofik, 2023). Communities with stronger adaptive capacity are generally better positioned to respond effectively to environmental stressors. Garcia et al. (2024) further argue that adaptive capacity is multidimensional and shaped by economic, institutional, social, and environmental factors. Utility Maximization Theory complements these perspectives by explaining adaptation choices as rational decisions influenced by perceived benefits, costs, risks, and expected outcomes. Farmers and households are more likely to adopt climate adaptation strategies when anticipated benefits outweigh existing livelihood risks (Ojo et al., 2023). Similarly, Atube et al. (2021) found that adaptation decisions among rural communities are strongly influenced by access to information, financial capability, and previous experiences with climate hazards.

Although climate change adaptation has received increasing scholarly and policy attention globally, empirical studies focusing on the lived experiences of local communities within Zambia's floodplain environments remain limited. Existing studies in Zambia have predominantly concentrated on technical adaptation interventions, agricultural productivity, and climate-smart technologies while paying insufficient attention to indigenous knowledge systems, socio-cultural dimensions, community perceptions, and local adaptation experiences. Furthermore, limited research has specifically examined how communities within the Barotse Plains interpret climate risks, negotiate adaptation challenges, and develop locally driven resilience strategies in response to recurrent floods and environmental uncertainty. This knowledge gap constrains the development of context-specific adaptation policies and community-based resilience interventions tailored to local realities. Therefore, this study investigates the experiences of local communities in adapting to climate change in the Barotse Plains of Zambia. The study contributes localized empirical evidence necessary for strengthening climate adaptation policy, promoting community resilience, and supporting sustainable rural development in climate-vulnerable environments.

MATERIALS AND METHODS

Research design

The study adopted a qualitative research approach grounded in hermeneutic phenomenology and informed by a Cultural Theory, Adaptive Capacity Theory, and Utility Maximization Theory. Phenomenology emphasises interpretation of lived experience, recognising that meaning is co-constructed through social interaction and contextual understanding rather than merely described (Addeo, 2013; Qazi and Rashidi, 2018b). This design was appropriate for investigating experiences of local communities on adapting to climate change.

Study Site

The study was conducted in Nalolo and Senanga Districts of Western Province, Zambia, both located within the Barotse floodplain ecosystem. These districts were purposively selected due to their high exposure to recurrent flooding, which significantly influences local livelihood systems such as flood-recession agriculture, fishing, and livestock rearing. The Barotse Plains represent one of the most climate-sensitive ecological zones in Zambia, characterized by annual inundation cycles that directly shape settlement patterns, food production systems, and mobility strategies. Nalolo and Senanga were specifically chosen because they represent variation in flood intensity, livelihood dependence, and access to infrastructure and services within the floodplain system. Senanga, being relatively closer to major trading routes, demonstrates slightly higher market integration, while Nalolo remains more remote with stronger dependence on subsistence-based adaptation systems. This variation allowed for a more comprehensive understanding of adaptation experiences across different socio-ecological contexts. Fieldwork was conducted in selected villages located in both low-lying flood-prone zones and upland relocation areas where households temporarily or permanently move during peak flooding periods. This dual settlement pattern provided critical insight into both in-situ and mobility-based adaptation strategies.

Target Population

The study population consisted of individuals directly engaged in floodplain livelihood systems, including small-scale farmers, livestock keepers, fishermen, fish traders, and local institutional actors involved in climate adaptation implementation. All participants were selected based on their lived experience of environmental variability and direct interaction with climate-induced livelihood disruptions. In line with phenomenological principles, inclusion was based on experiential relevance rather than statistical representation, ensuring that participants had meaningful exposure to the phenomenon under investigation (Creswell, 2013).

Sampling Methods

The goal of this study was not to recruit a representative sample, but rather to focus on participants who possessed similar characteristics that were relevant to the study (Creswell and Creswell, 2017). The researchers employed purposive non-random sampling method to recruiting the participants for the study. The selected participants shared similar characteristics and experiences (Bryman, 2016). In this regard, purposive sampling technique was

employed as a feature of qualitative research in order to enable the researchers to select knowledgeable participants.

Sample size

The sample size for this study was 22 participants. This sample size was considered sufficient once thematic saturation was achieved. In qualitative research, Smith and Osborn (2008) have advocated for a small sample size. This is because qualitative research is not aimed at making generalizations but having a holistic picture of the perspectives of people experiencing a similar phenomenon. Qualitative studies do not determine sample size statistically but seek information-rich participants and data saturation. As such, the commonality of their experiences were captured and interpreted. Thus in this study, the researchers conducted two (2) focus group discussions and two Key Informant Interviews (KIIs)with the district local officials and implementation officers.

Data Collection Methods

This research employed the focus group discussions (FGDs) and Key Informant Interviews through the use of semi-structured interviews to investigate the experiences of local communities on adapting to climate change. Smith et al (2009) suggested that semi-structured interviews are well-suited to the task of capturing people's lived experiences and through which a phenomenon could be interpreted in terms of the meanings interviewees bring to it. This type of interview was used to create a space in which the researcher and participants constructed the knowledge together (Birks and Mills, 2011). The interviews were conducted in participants' preferred languages (i.e., English and Lozi). Each participant was identified by pseudo names which were different from the actual names of the participants. The researchers preferred the FGDs and KIIs because they enabled the researchers to ask clarifying and probing questions, where the interviewers have the freedom to alter; rephrase and add questions according to the nature of the responses from interviewees (Best and Kahn, 2003). The semi-structured interviews also provided an opportunity for recording all the responses from participants.

Data Analysis and interpretation

Data were analysed using thematic analysis following Braun and Clarke's (2006) six-step model. Braun and Clarke recommended that qualitative research focuses on the following steps, namely: familiarization with the data, generating initial codes; searching for themes; reviewing themes; defining and naming themes, and producing the report. In this study, interviews were recorded with the consent of the participants. The audio recordings were then transcribed and uploaded into the qualitative research software called Nvivo version 15 pro to assist in organizing and coding data. Themes were interpreted using theoretical lenses, including Cultural Theory, Adaptive Capacity Theory, and Utility Maximization Theory. The researchers read through the transcripts identifying open codes using the qualitative software Nvivo. Coding aided in identifying concepts, categories and sub-categories that were further broken down. Open coding involves reading the texts 'word-by-word', 'line-by-line', and repeatedly to identify phrases that interviewees were using to describe things and issues. The coded data were then categorised (grouped) according to different characteristics to better understand the data. The categories were then grouped to form sub-themes and then eventually, the sub-themes were grouped to come up with the main themes. This enabled the researcher to categorize items according to what description they offered (Bryman, 2012).

Reflexivity and Positionality

The principle of reflexivity means that the researcher should be conscious about his/her own position, values, biases and decision in constructing knowledge of the social world in the research process right from designing the tools, data collection and interpretation of the findings (Hesse-Biber and Johnson, 2015). Being qualitative research, the researchers were aware that their background, values, beliefs, and experiences could influence the research process (Floyd and Arthur, 2012). To overcome the problem of positionality, the researchers had put aside any preconceived ideas or what they may have personally observed about the lived experiences of community residents in Nalolo and Senanga Districts in line with the recommendations by Greenbanks (2003) that reflexivity requires explicit self-consciousness and self-assessment about the researchers' views and positions and how these might influence the design, execution, and interpretation of research findings.

Additionally, the primary researcher had professional experience in mining and community development. To minimise bias, reflexive journaling, peer debriefing and regular consultation with the supervisor were employed throughout data collection and analysis.

Ethical Considerations

In any research conducted, ethical issues must be taken into consideration by the researcher (Bryman, 2016). The researchers ensured that ethics of social research were upheld. The main ethical issues addressed in the course of the research were; approval, permission, access and acceptance, informed consent, confidentiality, right to privacy and anonymity, right to withdrawal, beneficence, justice and fairness. The ethical approval number for the study is MU/DRI/REC/2026/008.

Study Findings (Results)

Introduction

This section presents and analyses the findings of the study on the experiences of local communities in adapting to climate change in the Barotse Plains of Zambia. The presentation is structured according to the study objectives and research questions, namely: experiences of local communities in climate change adaptation, indigenous and modern adaptation strategies, challenges faced during adaptation, and community-driven strategies for enhancing climate resilience. The findings were generated through interviews, focus group discussions, and key informant interviews with district implementing officers.

Specific codes and themes emerging from data

In line with the research design, the findings emphasized the importance of giving a voice to study participants. This approach is in line with the epistemological methods of understanding the social worlds based on the lived experiences of research participants.

Table 1: Emerging themes and subthemes

Themes	Sub-themes
General Experiences of Local Communities in Adapting to Climate Change	Gendered Vulnerability Expansion
3Indigenous and Modern Adaptation Strategies Used by Local Communities	Indigenous Adaptation Strategies
	Modern Adaptation Strategies
Challenges Faced by Communities in Climate Change Adaptation	Financial and Technological Constraints
	Declining Natural Resources and Environmental Pressure
	Weak Institutional Coordination and Governance Challenges
Community-Driven Strategies for Enhancing Climate Change Adaptation	Transformational Adaptation Perspective

Source: Field Data (2026)

General Experiences of Local Communities in Adapting to Climate Change

The findings indicate that climate change in the Barotse Plains is experienced not only as an environmental challenge but as a multi-dimensional crisis affecting economic stability, psychological well-being, and social cohesion. Adaptation practices are largely reactive, emerging after climate shocks rather than proactively anticipating them. Households described a persistent cycle of uncertainty driven by unpredictable floods and droughts. This instability disrupts agricultural planning, fishing cycles, and household food security, forcing families into short-term survival strategies.

The emotional burden of adaptation was particularly pronounced among vulnerable groups, especially female-headed households, where participants reported psychological stress, exhaustion, and livelihood anxiety. This aligns with emerging evidence that climate vulnerability is closely linked to mental health stressors in rural

settings (Cunsolo & Ellis, 2021; Niedzwiedz et al., 2025). Participants explained that adaptation often occurs only after climatic disasters have already occurred. One participant emotionally explained:

"Had not been for social cash transfer we would have been dead; we don't do anything we wait for the prevailing weather conditions that is when we adjust." (Participant 18)

This finding suggests the existence of reactive adaptation systems rather than anticipatory adaptation mechanisms. Communities largely depend on emergency coping responses instead of long-term preparedness strategies. The dependence on government social cash transfers also demonstrates how climate vulnerability has become intertwined with poverty and food insecurity. Another participant explained:

"It is a difficult question for me it brings bad memories especially how I invested my resources in farming this season only to experience high floods that is how I started cutting grass for selling and buy fishing nets but I have not recovered my money from farming." (Participant 4)

This response demonstrates the economic losses associated with climate variability. Farming investments are frequently destroyed by floods before crops mature, forcing households to abandon farming temporarily and shift into alternative livelihood activities such as fishing, grass cutting, and informal trading.

Gendered vulnerability expansion

A key finding is that adaptation burdens are unevenly distributed across gender lines. Women often carry dual responsibilities of caregiving and income generation, while having limited access to productive assets such as land, credit, and mechanized farming technologies. These structural inequalities shape differentiated adaptation outcomes and reinforce vulnerability. The emotional burden of climate change adaptation was also evident among female-headed households. One widow narrated:

"The question is too hard for me to explain as a widow, I am playing both roles of a woman and a man at the same time… Every day I spend sleepless nights thinking on how to bring food on the table." (Participant 11)

This finding demonstrates that climate vulnerability is gendered. Female-headed households face disproportionate adaptation burdens because women often carry caregiving responsibilities while simultaneously engaging in income-generating activities. The psychological stress associated with climate-induced poverty, food insecurity, and uncertainty was highly visible in participant narratives. The findings therefore reveal that climate adaptation experiences in the Barotse Plains are characterized by economic instability; emotional and psychological distress; dependence on natural resources; reactive survival strategies; gendered adaptation burdens; and chronic livelihood uncertainty. This supports feminist political ecology perspectives, which argue that environmental stress interacts with pre-existing gendered power relations to produce unequal adaptive capacities (Lund, 2025).

Based on these findings, the study suggest that climate adaptation in the Barotse Plains is not only an environmental issue but also a socio-economic and human security challenge requiring integrated interventions that combine livelihood support, mental health awareness, institutional strengthening, and climate-resilient development planning.

Comparative Indigenous Knowledge Analysis

Indigenous adaptation systems in the Barotse Plains share strong similarities with other African floodplain ecosystems such as the Okavango Delta (Botswana), Kafue Flats (Zambia), and Zambezi Delta (Mozambique). Across these regions, communities rely on environmental indicators such as animal behaviour, plant phenology, and hydrological changes to predict seasonal variation. However, the Barotse system demonstrates a stronger integration of flood-based agricultural mobility, where seasonal relocation is a central adaptation mechanism, compared to more sedentary flood adaptation systems in some other regions.

Despite these similarities, differences emerge in institutional integration. For example, the Okavango Delta has more structured eco-tourism and conservation governance, which influences adaptation financing, while the

Barotse Plains remain more dependent on subsistence-based systems with limited institutional reinforcement. These comparisons suggest that indigenous knowledge systems are highly context-specific but share common ecological principles across floodplain environments. However, their effectiveness is increasingly constrained by climate unpredictability and institutional neglect.

Indigenous and Modern Adaptation Strategies Used by Local Communities

The findings demonstrate that adaptation in the Barotse Plains is characterized by a hybrid knowledge system combining indigenous ecological knowledge and modern scientific interventions. However, the integration of these systems remains uneven and often hierarchical.

Indigenous Adaptation Strategies

The findings showed that indigenous knowledge systems remain highly trusted because they are embedded in lived experience and cultural memory. Participants mentioned that communities utilize traditional farming calendars, indigenous weather forecasting systems, flood-based farming, fishing practices, livestock management systems, and local environmental indicators to adapt to climatic changes. However, their reliability is increasingly challenged by climate variability, which disrupts historical environmental patterns. One participant explained:

"During summer us women catch small fish using baskets made out of grass (mashin'o)… As for men, they concentrate on catching big fish using fishing nets." (Participant 5)

This finding demonstrates the existence of gender-based adaptation roles within fishing systems. Women primarily engage in small-scale fish harvesting and fish marketing, while men engage in larger and more labor-intensive fishing activities. Fishing therefore functions as both an adaptation mechanism and a livelihood diversification strategy during flooding periods. Participants also explained that communities use flood monitoring techniques to protect homes during rising water levels. One participant stated:

"We usually monitor water levels around February and March… we block water using grass and soil so that it does not enter our houses." (Participant 3)

This demonstrates localized environmental knowledge and community-based disaster preparedness systems. The use of soil ridges, grass barriers, and elevated wooden platforms reflects indigenous flood management innovations developed through generations of environmental interaction. Agricultural adaptation strategies included cultivation of cassava, sweet potatoes, and squash using traditional hoes and flood-recession farming methods. One participant explained:

"Cassava and sweet potatoes get ready before floods reach our fields because canals and streams supply water." (Participant 7)

These findings indicate that local communities strategically cultivate early-maturing and flood-tolerant crops to minimize production losses. Cassava and sweet potatoes were preferred because of their resilience under fluctuating moisture conditions. The district implementing officer further explained that indigenous weather forecasting remains important within local communities:

"When there is a lot of wild fruit, the district will experience a lot of rain; the wind direction is also used; and even certain small ants are used to predict the rain season." (Key informant 2)

This demonstrates that indigenous climate forecasting systems continue to shape agricultural decision-making within the Barotse Plains. Such ecological indicators provide locally relevant climate information where formal meteorological services may be inaccessible or poorly disseminated.

Modern Adaptation Strategies

The findings further revealed modern adaptation strategies such as improved seed varieties, conservation agriculture, irrigation technologies, fertilizer application, climate information dissemination, and mechanized

farming are increasingly promoted by state and development actors. However, access to these technologies is highly unequal, reinforcing adaptation disparities. One participant explained:

"We rely so much on improved maize seed and fertilizer because indigenous maize takes longer to mature and gets flooded before flowering." (Participant 3)

This finding demonstrates the increasing reliance on climate-resilient crop varieties to reduce vulnerability to flooding. Early-maturing seed varieties are being adopted because they shorten production cycles and improve harvest possibilities before floodwaters rise. However, access to modern adaptation technologies remains highly unequal. Another participant stated:

"Hiring a tractor is K1500 per hour… but I cannot afford that amount." (Participant 11)

This finding highlights economic exclusion within climate adaptation systems. Poor households cannot access mechanized farming equipment, irrigation systems, or improved agricultural technologies because of financial limitations. The district implementing officers indicated that current interventions included: promotion of conservation agriculture; clearing of canals and drainage systems; distribution of drought-tolerant seed varieties; farmer field schools; and promotion of small-scale irrigation systems. These findings suggest that institutional adaptation efforts are already underway. However, implementation challenges continue to undermine their effectiveness and accessibility.

Knowledge politics and power relations

A critical issue emerging from the findings is the asymmetrical relationship between indigenous and scientific knowledge systems. Scientific knowledge is often institutionalized through formal extension systems, while indigenous knowledge remains informal and under-documented. This creates epistemological inequality, where local knowledge is frequently extracted for policy use without meaningful participation of knowledge holders. Effective adaptation therefore requires co-production frameworks that ensure equitable recognition of indigenous knowledge systems in decision-making processes. Mechanisms such as participatory knowledge mapping, community-based climate monitoring, and collaborative forecasting platforms are essential for bridging this gap.

Challenges Faced by Communities in Climate Change Adaptation

The findings revealed that climate adaptation in the Barotse Plains is constrained by multiple interconnected challenges including poverty, technological limitations, institutional inefficiencies, weak infrastructure, environmental degradation, and limited community participation in climate governance.

Financial and Technological Constraints

Participants consistently emphasized that inadequate financial resources limit their adaptive capacity. One participant explained:

"We do not have water pumps for irrigation, fertilizer is expensive, hiring tractors only a few can manage." (Participant 8)

This demonstrates that adaptation technologies remain inaccessible to most households because of poverty. The inability to afford irrigation systems, mechanized farming equipment, and agricultural inputs reduces production efficiency and increases vulnerability to crop losses. The findings further showed technological disparities between communities. One participant noted:

"Others use tractors to prepare fields but us we use homemade hoes." (Participant 3)

This indicates unequal access to agricultural modernization and adaptation infrastructure. Households with greater financial resources are better positioned to adopt climate-smart technologies than poorer households.

Declining Natural Resources and Environmental Pressure

Participants also reported declining fish stocks due to overfishing, population pressure, and unsustainable fishing practices. One participant explained:

"Outsiders have settled here and new fishing methods have contributed to depletion of fish." (Participant 16)

The findings indicate that climate stress is compounded by environmental degradation and unsustainable resource exploitation. Communities increasingly depend on fishing as agriculture becomes unreliable, thereby intensifying pressure on aquatic ecosystems. The use of prohibited mosquito-net fishing methods was also reported. Participants admitted that poverty forces households to use illegal fishing practices despite knowing their environmental consequences. This demonstrates how survival pressures can undermine environmental sustainability.

Weak Institutional Coordination and Governance Challenges

The findings further revealed widespread dissatisfaction with institutional support systems. Participants reported delayed agricultural inputs, corruption concerns, poor communication, and inadequate consultation. One respondent stated:

"Government released money towards climate adaptation but delivery is poor… equipment disappeared." (Participant 13)

This finding suggests governance and accountability challenges within climate adaptation programmes. Delayed implementation reduces the effectiveness of seasonal agricultural interventions. Another participant explained:

"We are not consulted… government decided to make mealie meal cheaper but we struggled to access it." (Participant 6)

This demonstrates the prevalence of top-down adaptation approaches that inadequately involve communities in decision-making processes. Lack of community participation weakens local ownership of adaptation interventions. District implementing officers also acknowledged institutional limitations including inadequate funding: poor roads and transport systems; procurement delays; limited fuel for field operations; and weak coordination among stakeholders. These findings indicate that institutional adaptation capacity remains insufficient to adequately support vulnerable communities in remote floodplain regions.

Role of traditional governance

Beyond poverty and infrastructure constraints, adaptation in the Barotse Plains is shaped by broader political economy dynamics that influence resource allocation and institutional performance. Climate adaptation funding is often mediated through centralized bureaucratic systems that prioritize national-level planning over localized needs. This results in delayed interventions, misaligned resource distribution, and limited accountability at the community level. Traditional institutions, particularly the Barotse Royal Establishment, play a significant role in land allocation, cultural governance, and community mobilization. However, their integration into formal climate governance structures remains limited. Strengthening collaboration between traditional authorities and government institutions could enhance legitimacy, local ownership, and responsiveness of adaptation interventions.

Community-Driven Strategies for Enhancing Climate Change Adaptation

The findings revealed that communities possess clear ideas regarding locally appropriate strategies that can strengthen climate adaptation in the Barotse Plains. Participants emphasized irrigation expansion, livestock-based farming systems, fisheries management, decentralisation of climate resources, and integration of indigenous knowledge into policy systems. One participant stated:

"If we collar and irrigate then we plant on time… our crops can mature before floods." (Participant 4)

This demonstrates community preference for integrated irrigation and water management systems capable of supporting year-round agriculture. Communities believe irrigation can reduce dependence on unpredictable rainfall patterns. Participants also proposed strengthening sustainable fisheries management. One respondent explained:

"If we restock our lakes with fingerlings and strengthen fisheries committees, we can reduce overfishing." (Participant 17)

This finding highlights the importance of community-based natural resource management systems. Participants recognize the need for sustainable fisheries governance to preserve livelihoods and aquatic biodiversity.

Another important recommendation involved reforming the Farmer Input Support Programme (FISP). Participants proposed that government support should include farming equipment such as; water pumps; oxen; ploughs; and irrigation infrastructure. This suggests that communities prefer productive adaptation assets over temporary consumption-oriented support systems. The district implementing officer emphasized that future adaptation interventions should integrate indigenous knowledge into formal climate adaptation policies:

"Indigenous knowledge should be systematically documented, validated and integrated into extension manuals and national adaptation policies." (Key informant 1)

This demonstrates growing recognition of indigenous ecological knowledge as an important resource for climate resilience building. The findings further suggest that successful climate adaptation in the Barotse Plains requires: participatory governance systems; improved infrastructure; decentralized climate financing; climate-smart agriculture; sustainable fisheries management; community empowerment; and stronger integration of indigenous and scientific knowledge systems.

Transformational adaptation perspective

Community proposals for improving adaptation reflect a strong preference for transformational rather than incremental adaptation approaches. These include irrigation expansion, fisheries management reforms, and decentralisation of climate financing. Findings suggest that incremental adjustments alone are insufficient under escalating climate uncertainty. Communities increasingly recognize the need for structural changes in livelihood systems, including diversification beyond climate-sensitive agriculture and fishing. Transformational adaptation implies shifts in production systems, governance structures, and resource distribution mechanisms that fundamentally reduce vulnerability rather than merely coping with shocks. However, such transformation must be socially just, ensuring that vulnerable groups are not excluded from new adaptation pathways.

Based on these findings, climate adaptation is shaped by severe livelihood vulnerability, poverty, institutional weaknesses, environmental uncertainty, and dependence on natural resources. Communities rely heavily on indigenous adaptation systems including flood-based farming, traditional forecasting methods, fishing systems, and local environmental knowledge. The study further established that although modern adaptation strategies such as conservation agriculture, improved seed varieties, irrigation promotion, and climate-smart farming are being introduced, their effectiveness is constrained by poverty, poor infrastructure, weak institutional coordination, and inadequate community participation. The findings also revealed that communities possess valuable locally grounded recommendations for strengthening adaptation systems including irrigation expansion, fisheries management, policy reform, decentralized climate financing, and integration of indigenous knowledge into formal adaptation planning.

DISCUSSION AND INTERPRETATION OF FINDINGS

This section discusses and critically interprets the findings in relation to the study objectives, research questions, theoretical framework, and existing empirical literature. The chapter demonstrates that climate change adaptation within the Barotse floodplain ecosystem is shaped by the interaction between indigenous ecological knowledge, socio-economic vulnerability, institutional governance, and emerging environmental pressures. The findings reveal that although communities possess strong localized adaptation knowledge, their adaptive capacity remains

constrained by poverty, weak institutional support, commercialization of natural resources, and limited access to climate-resilient technologies. The discussion further highlights the need for participatory and locally driven adaptation systems that integrate indigenous and scientific knowledge.

Experiences of Local Communities in Adapting to Climate Change

The study demonstrate that local communities in the Barotse Plains experience climate change primarily through increasing environmental uncertainty, fluctuating flood patterns, declining livelihood security, and social vulnerability. Participants reported that floods have become unpredictable in timing, duration, and intensity, making agricultural planning and livelihood management increasingly difficult. The contrast between destructive flooding during the 2025/2026 season and relatively favourable conditions during the 2024/2025 season illustrates the growing instability of floodplain ecosystems. These findings correspond with recent climate assessments indicating that Southern African floodplain systems are experiencing heightened hydrological variability due to climate change and altered rainfall regimes (IPCC, 2023; World Bank, 2022).

The study further established that climate change adaptation is not merely an environmental challenge but also a socio-psychological burden. Participants expressed fear, uncertainty, and emotional exhaustion associated with unpredictable climatic conditions and livelihood insecurity. The inability to predict flooding patterns disrupted crop production, fishing activities, livestock management, and children's education. Similar findings were reported by Cunsolo and Ellis (2018) and Niedzwiedz et al. (2025), who observed that prolonged exposure to climate-related disruptions contributes to climate anxiety, emotional distress, and psychological insecurity among vulnerable rural populations. The findings therefore suggest that climate adaptation policies should incorporate psychosocial dimensions of vulnerability rather than focusing exclusively on physical infrastructure and agricultural productivity.

The study also revealed widespread perceptions of institutional neglect and exclusion from national climate adaptation systems. Participants argued that most government interventions remain generalized and poorly adapted to the ecological realities of floodplain communities. Such findings reinforce Brondízio et al. (2021), who argue that centralized climate governance frameworks frequently marginalize local knowledge systems and overlook context-specific vulnerabilities. In the Barotse Plains, this institutional disconnect has compelled communities to rely heavily on localized coping mechanisms despite increasing climatic pressures.

These findings strongly support Adaptive Capacity Theory, which explains that vulnerability increases where communities lack access to economic resources, institutional support, infrastructure, and climate information. The findings also align with Cultural Theory, which emphasizes that environmental risks are socially interpreted through cultural experiences and lived realities. Communities in the Barotse Plains perceive climate change not simply as an environmental phenomenon, but as a disruption to social organisation, cultural identity, and economic survival.

Indigenous and Modern Climate Adaptation Strategies

The findings established that communities employ a combination of indigenous and modern adaptation strategies to cope with climate variability. Indigenous knowledge systems remain central to adaptation because they are embedded within local ecological experiences accumulated over generations. Participants reported using environmental indicators such as ant migration patterns, wind direction, fish movement, and wild fruit production to forecast rainfall and flooding conditions. These traditional forecasting systems continue to guide farming calendars, fishing activities, and seasonal migration decisions. Similar observations were made by Mapedza et al. (2022), who found that indigenous ecological knowledge remains highly relevant for localized climate adaptation across African rural communities.

The study further revealed that indigenous agricultural practices continue to support livelihood resilience within the floodplain ecosystem. Practices such as early cassava planting, crop diversification, animal corralling, and seasonal land-use adjustments were identified as important coping mechanisms against flood-related crop losses. These findings confirm Milupi et al. (2020), who argued that traditional floodplain farming systems are

ecologically adaptive because they evolved in response to cyclical flooding patterns and environmental variability.

However, the evidence also demonstrated that climate unpredictability has increasingly weakened the reliability of indigenous adaptation systems. Consequently, communities are gradually adopting modern adaptation approaches including hybrid seeds, irrigation technologies, mechanized farming, and chemical fertilizers. Farmers reported shifting from traditional maize varieties to early-maturing crops capable of surviving shortened rainfall seasons. Despite these transitions, adoption remains uneven because poorer households cannot afford mechanized farming equipment or agricultural inputs. The high cost of tractor hire and irrigation systems was repeatedly identified as a major barrier to adaptation. These findings support Garcia et al. (2024), who argue that climate adaptation inequalities are strongly linked to unequal access to financial and technological resources.

Importantly, the study identified emerging forms of maladaptation associated with modern adaptation practices. The illegal use of chemically treated mosquito nets for fishing was reported to be increasingly common due to growing commercial fish demand. While communities viewed this practice as economically beneficial in the short term, it has contributed to declining fish stocks and ecological degradation through indiscriminate harvesting of juvenile fish species. Similar concerns were raised by Eriksen et al. (2021), who caution that poorly regulated adaptation responses can unintentionally increase long-term environmental vulnerability.

The findings further revealed significant gender inequalities within adaptation processes. Women were largely restricted to shallow-water fishing and low-income livelihood activities, while men dominated commercial fishing operations and resource-intensive adaptation practices. These gendered divisions reflect broader socio-cultural norms influencing access to resources, mobility, and economic opportunities. Lund (2025) similarly observed that adaptation strategies are shaped by social power relations and household responsibilities. The findings therefore suggest that climate adaptation interventions must incorporate gender-responsive approaches to ensure equitable participation and benefit sharing.

These results indicate that neither indigenous nor modern adaptation systems are independently sufficient under accelerating climate change conditions. Indigenous systems provide context-specific ecological knowledge, while modern technologies offer opportunities for productivity enhancement and climate resilience. Effective adaptation in the Barotse Plains therefore requires integrated climate knowledge systems combining traditional ecological understanding with scientific innovation and institutional support.

Challenges Constraining Climate Change Adaptation

The study established that climate adaptation in the Barotse Plains is constrained by interconnected structural challenges including poverty, weak governance systems, technological limitations, environmental degradation, and inadequate institutional coordination. One of the most significant barriers identified was low household adaptive capacity resulting from widespread poverty and limited access to productive resources. Participants reported that they lacked irrigation systems, mechanized farming equipment, agricultural inputs, and financial capital necessary for effective adaptation. These findings support Adaptive Capacity Theory, which posits that communities with limited economic and technological resources are more vulnerable to climate shocks (IPCC, 2023).

The findings also revealed that increasing commercialization of natural resources has intensified environmental degradation within the floodplain ecosystem. Participants explained that rising market demand for fish has encouraged unsustainable fishing practices and increased migration into fishing zones, resulting in declining fish stocks and biodiversity loss. These findings align with Scheel (2025), who argues that market-driven resource exploitation frequently accelerates ecological vulnerability in fragile environments.

Institutional weaknesses emerged as another major challenge affecting adaptation efforts. Communities described government interventions as delayed, centralized, and poorly coordinated. Agricultural inputs often arrived after planting seasons, while development resources intended for communities were reportedly mismanaged. Institutional officers themselves acknowledged operational challenges including inadequate funding, limited transport, and weak monitoring systems. Similar findings were reported by Olanrewaju (2024),

who observed that centralized climate governance structures often fail to respond effectively to localized climate risks.

The study further identified the absence of rural financial systems as a critical limitation to adaptation. Participants reported limited access to agricultural credit, climate insurance, and adaptation financing. This restricted investment in climate-smart technologies and increased vulnerability during climate shocks. Alexis et al. (2021) similarly found that financial exclusion significantly limits the adoption of climate-resilient agricultural innovations among smallholder farmers in Sub-Saharan Africa.

Based on the discussion above, the results demonstrate that climate adaptation challenges in the Barotse Plains are largely structural rather than behavioural. Although communities possess valuable indigenous knowledge and willingness to adapt, their efforts remain undermined by poverty, governance failures, and unequal access to institutional and technological support.

Community-Driven Strategies for Strengthening Climate Adaptation

The findings revealed strong community support for locally driven and participatory adaptation strategies capable of enhancing long-term resilience in the Barotse Plains. Participants emphasized the importance of canal clearing, conservation farming, and improved water management systems to regulate flooding and enhance agricultural productivity. Such strategies demonstrate that communities possess substantial ecological understanding of local hydrological systems and floodplain management. The study further identified small-scale irrigation as a critical adaptation priority. Participants argued that irrigation systems operating between July and November would enable crops to mature before destructive flood periods. Similar findings were reported by Manda et al. (2024), who found that localized irrigation systems significantly improve resilience among floodplain farming communities exposed to climate variability.

Communities also proposed restructuring the Farmer Input Support Programme (FISP) to better align with floodplain ecological conditions. Participants recommended replacing fertilizer-centred subsidies with productive assets such as irrigation pumps, oxen, and climate-resilient farming equipment. This finding highlights the limitations of standardized national agricultural policies in ecologically diverse environments. The findings additionally emphasized the importance of decentralizing climate adaptation governance. Participants proposed strengthening local fisheries committees, expanding district-level climate financing, and increasing collaboration with the Barotse Royal Establishment to improve accountability and community participation. These findings support Soanes et al. (2020), who argue that locally led adaptation enhances legitimacy, responsiveness, and contextual relevance in climate governance.

The integration of indigenous knowledge with scientific climate forecasting also emerged as a key recommendation. Participants advocated for documenting traditional environmental indicators alongside meteorological forecasts to improve accessibility and trust in climate information systems. Such integrated approaches are increasingly recognized as essential for effective climate adaptation in vulnerable rural communities (Mafongoya and Badey, 2017).

The findings demonstrate that adaptation in the Barotse Plains is shaped by interacting systems of ecological uncertainty, institutional fragmentation, and socio-economic inequality. Climate variability is no longer predictable within historical patterns, making traditional adaptation strategies less reliable. Adaptive Capacity Theory is strongly validated, as households with greater access to resources, infrastructure, and institutional support demonstrate higher resilience. Conversely, Utility Maximization Theory explains why households adopt riskier strategies such as illegal fishing when survival pressures outweigh long-term environmental considerations. Cultural Theory further explains how adaptation is socially embedded; with perceptions of climate risk shaped by collective memory, cultural identity, and lived environmental experience.

Based on the discussions above, the results suggest that sustainable climate adaptation in the Barotse Plains requires a transition from centralized, top-down adaptation models toward participatory, locally grounded, and context-sensitive governance systems that strengthen community agency and adaptive capacity.

CONCLUSION

The study demonstrated that communities continue to utilize indigenous adaptation strategies such as seasonal migration, traditional flood forecasting, crop diversification, fishing practices, and local ecological knowledge because these methods are contextually relevant and culturally embedded. However, the study also established that indigenous systems alone are increasingly insufficient due to intensified climate variability and environmental unpredictability. Consequently, communities have gradually adopted modern adaptation approaches including hybrid seed varieties, irrigation technologies, conservation farming, and mechanized agricultural practices. The study further found that climate adaptation efforts remain constrained by poverty, inadequate infrastructure, weak institutional coordination, limited access to climate information, and delayed policy implementation. Centralized adaptation policies were perceived as insufficiently responsive to the ecological realities of floodplain communities. Therefore, the study concludes that climate adaptation in the Barotse Plains is a dynamic and contested process shaped by ecological stress, socio-economic inequality, institutional limitations, and knowledge pluralism. While indigenous systems remain essential for survival, increasing climate unpredictability necessitates stronger integration with scientific systems, improved governance structures, and inclusive policy frameworks. However, sustainable adaptation cannot be achieved without addressing structural inequalities in resource access, gender relations, and institutional accountability.

RECOMMENDATIONS

The study recommends that government institutions, development partners and local governance structures facilitate the establishment of co-produced climate knowledge platforms integrating indigenous and scientific forecasting systems. There is also need for the institutionalization of district-level adaptation governance platforms involving traditional authorities such as the Barotse Royal Establishment. Additionally, the introduction of gender-responsive adaptation programming, including targeted access to land, credit, and extension services for women; development of transformational adaptation pathways, including livelihood diversification beyond flood-dependent systems; strengthening of climate justice-oriented financing mechanisms to ensure equitable resource distribution to vulnerable communities; implementation of scenario-based adaptation planning frameworks to prepare communities for uncertain future climate conditions. Future studies should undertake quantitative research to investigate the economic costs of maladaptation, institutional inefficiencies, and household resilience outcomes associated with climate adaptation interventions.

Limitations of the Study

The study was limited to selected communities within the Barotse Plains, thereby restricting the broader generalization of findings to other ecological regions of Zambia with different climatic and socio-economic conditions. The research also relied predominantly on qualitative methods, meaning that findings were based largely on participants' lived experiences, perceptions, and subjective interpretations of climate adaptation practices. Financial, logistical, and seasonal flooding challenges further limited prolonged engagement with some remote settlements, which may have reduced the diversity of perspectives captured during data collection. In addition, climate change remains dynamic and evolving; therefore, adaptation experiences and coping strategies may change over time beyond the study period. Despite these limitations, the study generated valuable insights into community-based climate adaptation within floodplain environments. These findings provide an important empirical foundation for designing inclusive, context-specific, and sustainable climate adaptation policies in Zambia and similar floodplain environments across Sub-Saharan Africa.

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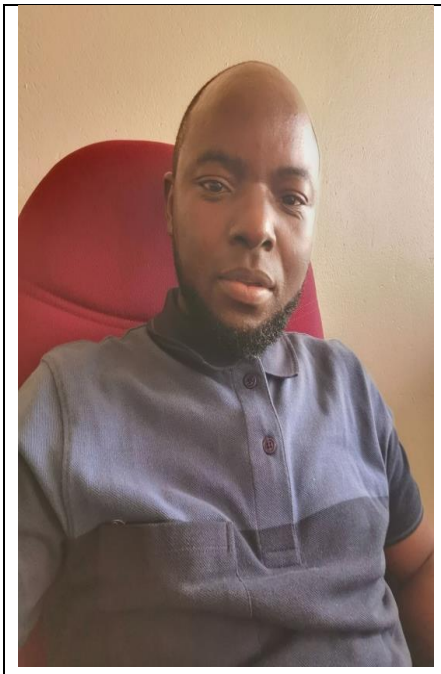	**Wilson L. Phiri** holds a Bachelor of Arts Degree in Sociology with Development Studies (BA-UNZA) and a Master of Arts Degree in Sociology from the University of Zambia (MA-UNZA), Zambia. He is currently a full-time Lecturer in the Department of Social Development Studies (SDS) under the School of Social Sciences at Mulungushi University, Zambia, where he teaches Sociology and Social Science Research courses. Wilson L. Phiri has extensive experience in academia and the corporate sector, including tutoring, lecturing, research supervision, training, data collection, and research consultancy. His academic and professional expertise spans qualitative research, mixed methods research, social institutions and poverty reduction, violence studies, social impact assessment, and sociological theories. His research interests include anthropological development, culture and development, project planning and evaluation, community development, rural and urban development, contemporary social issues in development, youth, crime and deviance, family and violence, and informal sector employment. His scholarly work focuses on addressing social and developmental challenges through evidence-based research and community-oriented approaches.