A Framework for Community-Based Adaptation to Floods in Semi-Arid Regions: Lessons from Ringim, Jigawa State

Musa Mustapha Danraka[1,2*], Sapura Binti Mohamad[3], Siti Nur Hannah Binti Ismail[4]

[1*,3,4] Department of Landscape Architecture, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia

[2*] Department of Architectural Technology, School of Environmental Studies, Nuhu Bamalli Polytechnic, Km5, along Kano-Kaduna Expressway. P.M.B 1061, 810241, Zaria. Kaduna State. Nigeria

Corresponding author: danraka@graduate.utm.my
https://doi.org/10.61211/mjqr110207

ABSTRACT

Flooding has emerged as one of the most recurrent and devastating environmental challenges in Nigeria, particularly in semi-arid regions like Ringim, Jigawa State, where climate variability, poor drainage infrastructure, and rapid urbanisation intensify community vulnerability. Floods are becoming an increasingly significant threat to communities in semi-arid regions, where erratic rainfall patterns exacerbate vulnerability. This study focuses on developing a framework for Community-Based Adaptation (CBA) to floods in the semi-arid region of Ringim, Jigawa State, Nigeria. Given the socio-economic challenges and environmental conditions in this area, there is a pressing need for sustainable, locally driven strategies to enhance community resilience. The research adopts a qualitative approach, utilising Focus Group Discussions (FGDs) with key stakeholders, including community leaders, NGO members, public officers, professionals, and academics. Five FGDs were conducted to gather insights into current adaptation measures, perceived gaps, and opportunities for improvement. Data from these discussions were analysed thematically in QSR NVivo to identify critical components for a robust adaptation framework. Findings reveal that while some community-driven initiatives have successfully mitigated flood impacts, significant gaps remain in coordination, capacity building, and infrastructure development. The framework developed through this study emphasises the importance of community engagement, government support, and the integration of traditional knowledge with modern adaptation practices. It highlights the need for improved early warning systems, floodplain management, and sustainable agricultural practices to enhance resilience. This study offers evidence-based insights to guide the development of inclusive and locally grounded adaptation policies. This study recommends a multi-stakeholder approach that combines local expertise and external resources to address these gaps. Further research is recommended to investigate the long-term effectiveness of the proposed framework across various semi-arid contexts and to evaluate the impact of climate change will shape future flood risks.

Keywords: Community-based adaptation, Flood management framework, Local adaptation strategies, Semi-arid regions, Vulnerability reduction

INTRODUCTION

Flooding has emerged as a significant environmental and socio-economic challenge, particularly in semi-arid regions where unpredictable rainfall patterns and poor water management systems exacerbate vulnerabilities. Semi-arid areas, characterised by limited rainfall and prolonged dry seasons, are often perceived as regions less prone to floods (Boafo et al., 2020; Nabinejad & Schüttrumpf, 2023; Rezaei-Sadr & Eslamian, 2022). However, these areas are increasingly experiencing extreme weather events driven by climate variability, leading to recurrent, often devastating floods. (Bolan et al., 2023; Ndlovu et al., 2020). Ringim, located in Jigawa State, Nigeria, exemplifies such regions where communities face heightened exposure to flood risks.

In Ringim, socio-economic and environmental factors, such as reliance on rain-fed agriculture, poor infrastructure, and ineffective flood management systems, contribute to the area's vulnerability (Muhammad & Rilwanu, 2020). The combination of fragile livelihoods, poverty, and limited governmental resources has further complicated

efforts to enhance community resilience. Environmental factors, such as land degradation, deforestation, and inadequate drainage systems, exacerbate the impact of flooding events, frequently resulting in loss of life, displacement, and property destruction. The need for localised and sustainable strategies to adapt to these recurrent floods is critical to safeguard livelihoods and reduce community vulnerability (Mairiga & Ibrahim, 2021).

The purpose of this study is to address the challenges faced by semi-arid regions in flood management by developing a CBA framework for flood management in semi-arid areas, using Ringim as a case study. The framework aims to offer practical recommendations for enhancing flood preparedness, response, and recovery, while also addressing socio-economic disparities and environmental concerns in flood-prone areas. The proposed framework should integrate traditional knowledge, local capacities, and external resources to enhance community resilience. Thus, the research question is: How can a CBA framework be developed to improve flood resilience in semi-arid regions, taking into account the socio-economic and environmental factors specific to Ringim, Jigawa State?

BACKGROUND TO THE STUDY

Community-Based Adaptation (CBA)

Community-Based Adaptation (CBA) has gained significant attention in recent years as a strategy for addressing climate change impacts at the grassroots level. It emphasises the active involvement of local communities in identifying, planning, and implementing adaptation strategies tailored to their specific socio-economic and environmental contexts. According to Reid et al. (2014, 2016), CBA builds on the knowledge and practices of local people, incorporating both traditional knowledge and scientific insights (Reid & Huq, 2014). Studies by Schipper et al. (2014) and Ayers & Forsyth (2009) underscore the importance of community participation in adaptation, as locally-driven solutions tend to be more sustainable and culturally appropriate.

In semi-arid regions, where livelihoods are often tied to natural resources, CBA plays a crucial role in enhancing resilience to climate-induced disasters, such as droughts and floods. However, the literature highlights challenges, including limited resources, inadequate institutional support, and socio-economic constraints, which hinder the effectiveness of community-led initiatives (Spires et al., 2014). These issues are particularly relevant in regions like Ringim, where poverty and underdevelopment exacerbate vulnerability.

Flood Management in Semi-Arid Regions

Flood management in semi-arid regions poses unique challenges due to their climatic variability. Flooding in these areas often results from short, intense rainfall events that overwhelm existing drainage systems, leading to flash floods. Studies by Kantoush et al. (2022), Soares et al. (2021) and Wilby & Keenan (2012) emphasises that flood events in semi-arid regions are becoming more frequent and severe due to climate change, which causes irregular rainfall patterns and exacerbates flooding risks.

Existing flood management strategies in semi-arid regions have typically focused on large-scale infrastructural solutions, such as dams and levees (Cutter et al., 2013; Kantoush et al., 2022). However, these strategies often overlook the needs and capacities of local communities, who are the most directly affected. The literature, including studies by Adger et al. (2005) and Hadlos et al. (Hadlos et al., 2022), highlights the importance of integrating local knowledge and practices into flood management plans, especially in areas where formal infrastructure is inadequate. There is growing recognition that a hybrid approach combining infrastructure with community-based measures is necessary to reduce flood risks effectively.

Resilience in Semi-Arid Regions

Resilience, defined as the capacity of communities to withstand, adapt to, and recover from environmental shocks, is a central concept in discussions about climate change adaptation (Folke et al., 2010). In semi-arid regions, resilience is often tied to the ability to adapt agricultural practices, manage water resources, and prepare for climate-related disasters. According to Bahadur et al. (2010), building resilience requires addressing both immediate vulnerabilities (e.g., lack of flood defences) and long-term socio-economic development (e.g., poverty reduction).

Research on resilience in semi-arid areas has revealed that successful adaptation strategies must be context-specific and locally driven (Nelson et al., 2007). This is particularly true in regions like Ringim, where adaptive capacity is constrained by limited government support, weak infrastructure, and socioeconomic disparities. Literature by Moser & Ekstrom (2010) highlights the need for flexible, inclusive frameworks that ensure all community members, including marginalised groups, are part of the adaptation process.

Gaps in the Literature

Despite the growing body of literature on CBA, flood management, and resilience, significant gaps remain, particularly in semi-arid regions like Ringim. Most of the existing literature focuses on large-scale, top-down approaches to flood management, with limited attention to the role of communities in shaping and implementing adaptation strategies. While studies such as Few et al. (2017, 2021) emphasise the importance of local participation, there is a need for more research on how community-based approaches can be effectively scaled and sustained in resource-constrained settings.

There is limited literature on the intersection of socio-economic and environmental factors in determining flood vulnerability in semi-arid regions. Studies like those of Thomas & Twyman (2005) acknowledge the role of poverty, but few have addressed how to incorporate socioeconomic disparities into adaptation frameworks. This gap is particularly relevant in Ringim, where poverty, limited infrastructure, and environmental degradation combine to increase the region's susceptibility to floods.

Despite increasing scholarly interest in CBA in relation to flooding, the existing body of literature is notably deficient in context-specific arguments and rationalisations that adequately address the distinctive challenges encountered in semi-arid regions, such as Ringim. Numerous studies proffer broad, generalised frameworks that fail to incorporate local socio-economic and cultural contexts, thereby constraining their practical applicability (Ayers & Forsyth, 2009; Reid & Huq, 2014). Furthermore, the incorporation of Indigenous knowledge and communal structures (elements that are pivotal in locales like Ringim) is frequently underexamined or inadequately integrated into formal adaptation frameworks (Ensor & Berger, 2009).

Moreover, the aspects of long-term sustainability, institutional coordination, and policy endorsement for CBA initiatives are often neglected, notwithstanding their essential function in facilitating effective and scalable interventions (Few et al., 2017). In addition, adaptation models typically extract insights from coastal or forested regions without taking into account the environmental degradation, water scarcity, and inadequate infrastructure that characterise numerous semi-arid communities (Adger et al., 2005). Consequently, a significant gap persists in the literature regarding localised, actionable, and sustainable CBA strategies explicitly designed for flood resilience in semi-arid contexts.

METHOD

This study adopts a qualitative research approach, which is well-suited for exploring complex socio-economic and environmental issues (Cartwright & Igudia, 2023), particularly in the context of CBA to floods. Qualitative methods allow for in-depth insights into the perceptions, experiences, and strategies of local communities (Cantelmi et al., 2021), which are crucial for developing a context-specific adaptation framework. Focus Group Discussions (FGDs) were chosen as the primary data collection method because they facilitate interactive discussions among stakeholders (Khan & Abedin, 2022), enabling a deeper understanding of community perspectives and collective decision-making processes.

The Study Area: Ringim, Jigawa State

The study area, Ringim, is situated within Jigawa State, Nigeria (see Figure 1). It is located in the northwestern sector of the state, covering an area of approximately 1,057 square kilometers and is home to an estimated demographic of 257,100 inhabitants (Mairiga & Ibrahim, 2021). Ringim is a semi-arid region characterised by a dry climate and seasonal rainfall. It lies within the Sudan-Sahel zone, where rainfall is often erratic and insufficient, creating vulnerability to both droughts and floods (Muhammad & Rilwanu, 2020). Although the region experiences a short rainy season, typically from June to September, heavy downpours during this period frequently result in flash floods, causing significant damage to farmlands, homes, and infrastructure (Mairiga & Ibrahim, 2021).

The socio-economic structure of Ringim is predominantly agrarian, with most of the population engaged in farming and livestock rearing. However, the dependence on rain-fed agriculture and the lack of resilient infrastructure exacerbate the community's susceptibility to climate-related shocks (Lawal et al., 2020). Limited access to modern flood mitigation technologies and early warning systems further intensifies the community's vulnerability.

Socioeconomic challenges, including poverty, low literacy rates, and inadequate access to government resources, create significant barriers to effective flood adaptation. Traditional knowledge and coping mechanisms, though valuable, are often insufficient to address the increasing frequency and intensity of flooding due to climate change (Mairiga & Ibrahim, 2021).
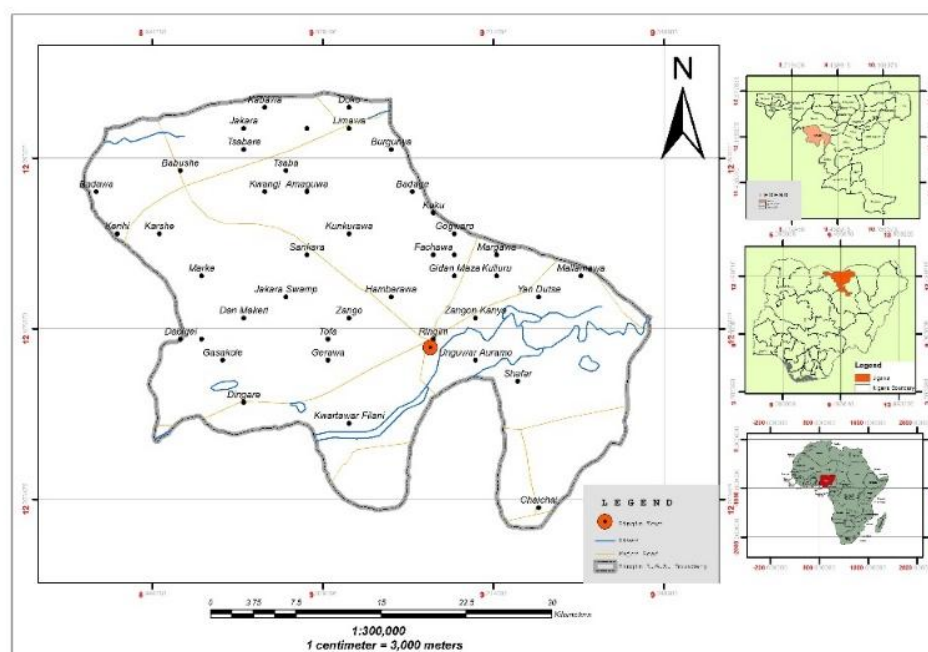
Figure 1: Location Map of Ringim
Source: Author's Analysis in ArcGIS, 2024

In recent years, governments and NGOs have made efforts to introduce adaptation strategies, but these have been largely reactive, focusing on post-disaster recovery rather than proactive resilience-building measures (Muhammad & Rilwanu, 2020). This context makes Ringim an ideal location to explore CBA frameworks that can strengthen resilience and reduce flood vulnerability in semi-arid regions.

Data Collection
A total of five FGDs were conducted with key stakeholders in Ringim, Jigawa State. The five groups who participated in the FGDs were the community leaders, NGO members, public officials, professionals, and academic members. These groups were selected to ensure a diverse range of views and experiences regarding flood adaptation, as each group plays a unique role in the community's response to floods. The FGDs were conducted between February 4, 2023, and February 24, 2024. Each FGD lasted 65-80 minutes and was held at venues convenient and comfortable for the participants. English was the primary language used during the FGDs, except for the community leaders, who used a mix of English and Hausa (the local language). Table 1.0 below presents the demographics of the participants in the FGDs for this study.

Selection of Participants
Participants for the FGDs were purposively selected based on their roles and relevance to flood management and adaptation in Ringim. As shown in Table 1, five different groups were involved. Each focus group consisted of four to eight participants, ensuring a manageable size that allowed for open discussion while capturing a range of perspectives. The researcher acted as the moderator in each of the five FGDS. The following provides a detailed description of each group.

The community leaders are the traditional rulers and local authorities who hold influence within the community and are responsible for mobilising local resources during flood events. The group consists of older males, primarily farmers aged 54–63, with modest incomes and limited educational attainment, who contribute deep local knowledge and traditional practices through their lifelong residency in the community. The NGO members are representatives from local and international organisations involved in disaster risk reduction, humanitarian aid, and development projects. All are males, aged 34-50, ranging from traders to artisans, with secondary to degree-level education, moderate incomes, and long-term residency, offering practical perspectives on mobilising local resources. Public Officers refer to government officials from relevant agencies, such as environmental management, water resources, and agriculture, who are involved in policy-making and the implementation of flood mitigation measures. They are mostly males, aged 39-54, and are experienced civil servants with high educational backgrounds, bringing policy and administrative expertise and influencing local governance. The

professionals involved in this study include architects, landscape architects, engineers, hydrologists, and town planners who contribute their technical expertise to flood management efforts in the region. There are males, aged 38-50, well-educated and financially stable, providing technical insights on infrastructure with significant residency experience. Lastly, the academics are the researchers with expertise in climate change, hydrology, and environmental science, providing insights into scientific approaches to flood adaptation. There are four male lecturers and one female lecturer, aged 38-49, who hold advanced degrees and contribute research-driven perspectives, earning relatively higher incomes that bridge academic knowledge with community needs.

The FGD participants' varying levels of income, education, and professional backgrounds reflect both the challenges and opportunities within the community, and their extensive residency in Ringim indicates a deep-rooted understanding of local needs and limitations in flood adaptation efforts. These participants offer a balanced mix of traditional, technical, institutional, and research-based perspectives, which are essential for crafting a practical community-based adaptation framework for flood resilience in Ringim.

Table 1: Participants' Demographics in the FGDs

FGD Group	Participants	Age	Occupation	Qualification	Period of FGD related to Flood	Income (#)	Years of Residency
Community Leaders (CL) (N=7)	1	63	Farmer	Non-formal	Pre-Flood	25,000	Since birth
	2	61	Farmer	Secondary		28,000	Since birth
	3	63	Farmer	Non-formal		25,000	Since birth
	4	54	Teacher	Degree		25,000	Since birth
	5	60	Farmer	Primary		15,000	40
	6	60	Trader	Primary		20,000	45
	7	61	Farmer	Primary		25,000	47
NGO's (NG) Members (N=5)	1	50	Trader	Degree	Pre-Flood	30,000	43
	2	34	Artisan	Secondary		15,000	Since birth
	3	45	Trader	Diploma		20,000	Since birth
	4	43	Artisan	Diploma		50,000	Since birth
	5	40	Farmer	Degree		15,000	25
Professional (PRO) Members (N=7)	1	49	Architect	Masters	Post-Flood	95,000	30
	2	45	Architect	Masters		80,000	25
	3	50	Town Planner	Bachelor		75,000	35
	4	38	Land Surveyor	Higher Diploma		65,000	20
	5	40	Civil Engineering	Bachelor		95,000	20
	6	38	Architect	Masters		80,000	18
	7	41	Builder	Higher Diploma		45,000	20
Public Officers (PO) Members (N=4)	1	54	Civil Servant	Degree	During Flood	130,000	45
	2	39	Civil Servant	Masters		110,000	25
	3	48	Civil Servant	Higher Diploma		85,000	Since birth
	4	44	Civil Servant	Degree		90,000	30
Academic (ACD) Members (N=5)	1	42	Lecturer I	Masters	Post-flood	150,000	25
	2	38	Lecturer II	Masters		130,000	20
	3	49	Senior Lecturer	PhD		185,000	30
	4	44	Lecturer I	Masters		150,000	28
	5	40	Lecturer II	Masters		130,000	25

Source: Author's fieldwork Compilation, 2024

Discussion in the FGDs

The FGDs were structured around predefined issues to ensure discussions remained focused on the study's objectives while allowing flexibility to explore new ideas. The following four issues were discussed during the FGDs. First, the challenges in current flood adaptation were identified: Participants were asked to identify the significant barriers to effective flood adaptation in the community, including socio-economic constraints, environmental challenges, and institutional gaps. Second, participants shared examples of successful adaptation strategies: community-led or externally supported approaches that have effectively mitigated flood impacts in Ringim. Third, there are gaps in existing approaches: Discussions explored the limitations of current adaptation measures at both the community and government levels and identified areas where further support or innovation is needed. Lastly, there are opportunities for collaboration: Participants explored ways to enhance flood resilience through cooperation among local communities, NGOs, and government agencies. All the discussions were recorded, transcribed, and analysed to identify recurring themes and insights relevant to building the adaptation framework.

DATA ANALYSIS

Analytical Approach

Data from the FGDs were analysed using a thematic analysis approach. This method was chosen because it allows for the identification of key patterns and themes that emerge from qualitative data (Braun & Clarke, 2022; Christou, 2022), making it ideal for understanding the complex social dynamics and environmental challenges of flood adaptation in Ringim. The thematic analysis constitutes a methodological approach aimed at recognising, scrutinising, and interpreting qualitative data (Khan et al., 2025), and it represents a systematic data analytical process wherein themes and relational dynamics are formulated by discerning specific statements or phrases within the data (Othman et al., 2021). The analysis followed these steps:

1. Familiarisation: The transcripts from the FGDs were read and re-read to gain a deep understanding of the content.
2. Coding: Key segments of the data were coded to capture the central ideas discussed by participants. Codes were grouped into broader themes related to flood adaptation, such as "community-led initiatives," "infrastructure challenges," and "institutional support."
3. Theme Development: The codes were organised into overarching themes that reflected the main insights from the discussions. These themes formed the basis for the adaptation framework, highlighting both the strengths and weaknesses of existing strategies.

RESULTS AND DISCUSSION

The five FGDs provided valuable insights into the community's current adaptation practices, challenges, and opportunities for improving resilience to floods in Ringim, Jigawa State. The discussions revealed five themes, highlighting the complex interplay of socio-economic, environmental, and infrastructural factors that influence the community's ability to adapt to flooding. They are: Socio-Economic Challenges, Existing Infrastructure and Flood Management, Environmental Degradation, Successful Adaptation Strategies, and Institutional and Policy Gaps.

Theme 1: Socio-Economic Challenges

One of the most prominent themes across all focus groups was the significant impact of socio-economic conditions on the community's ability to adapt to floods. Participants, especially community leaders, academics (emphasising socio-economic barriers - Figure 2), and NGO member groups, emphasised the prevalence of poverty, which limits access to resources necessary for effective adaptation. Many families depend on subsistence farming, making them highly vulnerable to crop losses during floods. The lack of diversified income sources exacerbates this vulnerability, as there are few financial safety nets to fall back on during crises.

Participants noted that limited access to formal education and information further hampers the community's understanding of flood risks and their ability to implement adaptive strategies. While some community members rely on traditional knowledge, there is a gap in accessing modern tools and technologies that could enhance resilience. As one community leader remarked, *"We know the rains are coming, but we don't always know how much or how severe they will be."* Similarly, an NGO member stressed, *"Most of our people depend on farming; when the floods destroy the crops, it means hunger for months because there are no other jobs."* An academic participant further added, *"Without education and economic empowerment, adaptation becomes very difficult. People can only respond within the limits of their means."*
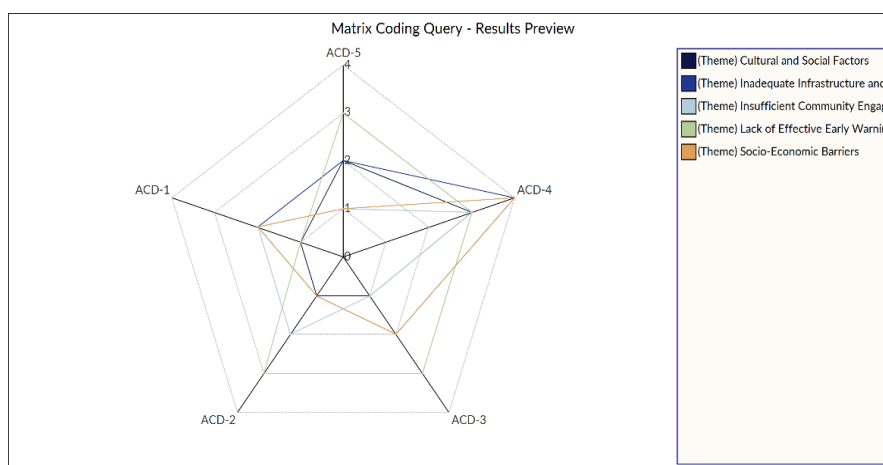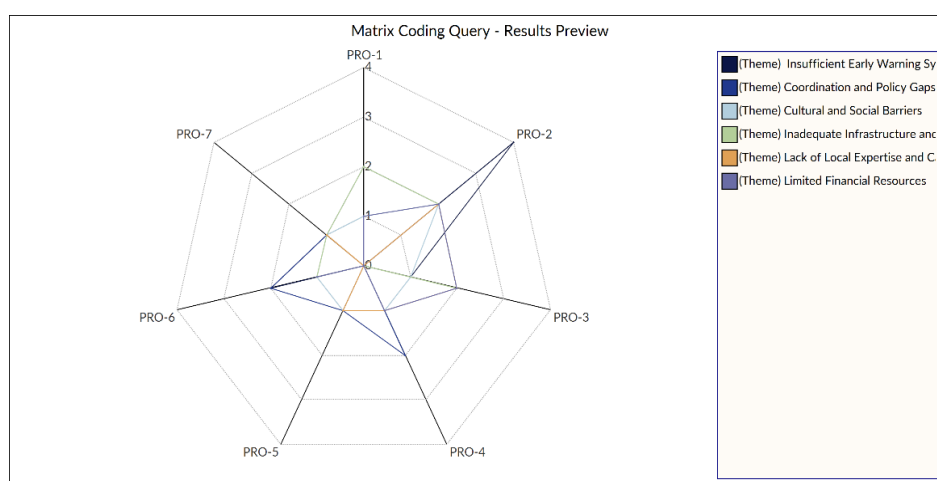
Figure 2: Matrix Coding Analysis of FGD with Academics
Source: Author's Analysis in QSR NVivo, 2024

Theme 2: Existing Infrastructure and Flood Management
The FGDs with public officers and professionals (Figure 3) highlighted the inadequacy of infrastructure as a significant barrier to effective flood management. Participants highlighted the inadequate drainage systems, unpaved roads, and the absence of flood protection measures, such as embankments or levees, in key flood-prone areas. Government officers acknowledged that infrastructure projects in Ringim are often delayed or underfunded, leaving communities vulnerable to repeated flooding.

Participants discussed the issue of informal settlements and poor urban planning, which often exacerbate flood risks. These settlements are typically situated in low-lying areas with limited drainage, making them particularly vulnerable to flooding. As one public officer noted, *"When the rains come, it's not just the volume of water; it's where the water is going. Without proper drainage, the water stays."* The professionals further emphasised that the lack of maintenance and technical oversight compounds the problem. One of them observed, *"Most of the existing drains are blocked because they are never cleaned, and people throw waste inside them. Even the roads we have are not designed to channel water properly."* Similarly, a public officer from the works department remarked, *"Many of our roads and culverts were built years ago without considering the current rainfall patterns. We now see flooding in places that never used to flood before."*

The professionals also discussed the issue of informal settlements and poor urban planning, which often exacerbate flood risks. These settlements are typically situated in low-lying areas with limited drainage, making them particularly vulnerable to flooding. One professional added, *"People build houses anywhere there is space, even across natural drainage paths. Without proper planning and enforcement, we will keep facing the same problems."*


Figure 3: Matrix Coding Analysis of FGD with Professionals
Source: Author's Analysis in QSR Nvivo, 2024

Theme 3: Environmental Degradation

Environmental concerns were also a central theme, particularly in the FGDs with professionals and academics. Deforestation, drought, and land degradation, driven by population pressure, poor information dissemination (Figure 4), and unsustainable agricultural practices, were cited as major contributors to increased flood risks in Ringim. Participants noted that removing vegetation, particularly along riverbanks and floodplains, reduces the land's natural capacity to absorb excess water, thereby increasing the severity of flooding. One professional explained, *"People cut trees for firewood and farming without planting new ones. Over time, the soil becomes bare, and when the rains come, the water just runs off and causes flooding."*

Participants also highlighted the role of climate change in exacerbating flood risks. They observed that while floods have always been part of life in Ringim, recent years have seen more intense, unpredictable rainfall. One academic reflected, *"Before, we could predict the rain and prepare our farms, but now the pattern is confusing—sometimes heavy rain comes suddenly and destroys everything."* This unpredictability makes it increasingly difficult for communities to rely solely on traditional coping mechanisms. The discussions highlighted the role of climate change in exacerbating flood risks. Participants noted that while floods have always been part of life in Ringim, recent years have seen more intense, unpredictable rainfall.
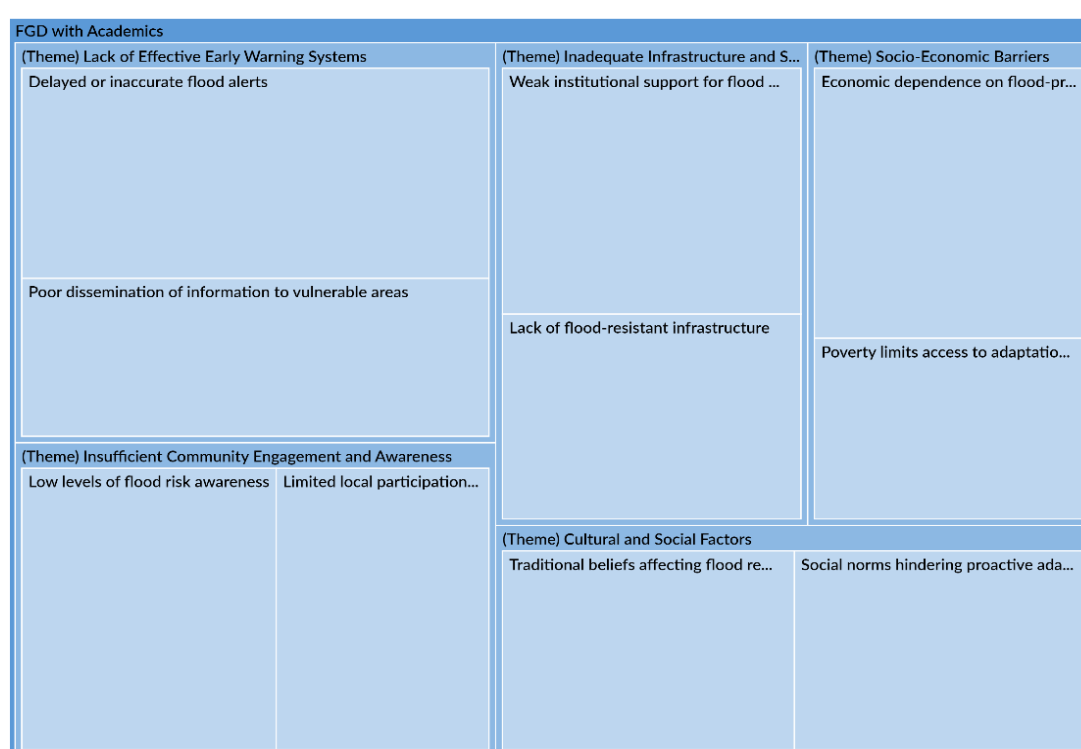
Figure 4: Hierarchy Charts of Codes for the FGD with Academics
Source: Author's Analysis in QSR NVivo, 2024

Theme 4: Successful Adaptation Strategies

The FGDs revealed several community-led initiatives that have been relatively successful in mitigating the impacts of floods. Community leaders and NGO members discussed how some villages have developed early warning systems based on traditional knowledge, such as monitoring river levels and changes in weather patterns. One community leader shared, *"Our elders know how to read the signs of the coming rain. When the river starts rising and the wind changes direction, we warn people to move their animals and protect their homes."* Such locally grounded approaches have helped to reduce loss and damage, especially in communities with limited access to modern technology.

Communal efforts to clear drainage channels before the rainy season have also proven effective in minimising localised flooding in some areas, even with inadequate knowledge and training (Figure 5). As another community leader explained, *"Every year before the rains, we gather the youth to clean the waterways. It is not perfect, but it helps the water to flow and reduces flooding in our streets."* These collective actions demonstrate the strength of social cohesion and local initiative in Ringim's communities.

The FGDs with NGO members also highlighted the role of external support in strengthening adaptation capacities. Training programs in climate-smart agriculture and sustainable water management have equipped farmers with essential skills to cope with floods. One NGO participant remarked, *"We train farmers to use simple water-harvesting techniques and better seeds that can survive heavy rain. Those who attend the training are seeing real improvements."* However, participants emphasised that such programs are limited in reach and sustainability due to financial and logistical constraints.

Additionally, four factors have been identified as key influencers of adaptation efforts in Ringim: socio-economic condition, existing infrastructure, environmental concerns, and, lastly, institutional support. First is the socio-economic condition: poverty, limited access to education, and a lack of diversified livelihoods significantly reduce the community's ability to adapt. Poor households are less able to invest in protective measures, such as elevating homes or purchasing flood insurance. Second, there is the existing infrastructure: inadequate drainage systems and road networks exacerbate flood risks. The absence of formal flood defences leaves communities highly vulnerable to even moderate flood events. Third is the environmental concerns: Deforestation, soil erosion, and other forms of land degradation reduce the land's ability to absorb water, leading to more severe flooding. Climate change is intensifying these risks, as rainfall patterns become more erratic. The fourth factor is institutional support: limited coordination among government agencies and weak policy implementation hinders effective flood management. There is a clear need for stronger institutional frameworks that involve communities in planning and decision-making.

The findings from the FGDs underscore the multi-dimensional nature of flood adaptation in semi-arid regions like Ringim. While the community has developed some successful adaptation strategies, these efforts are constrained by broader socio-economic and infrastructural challenges.
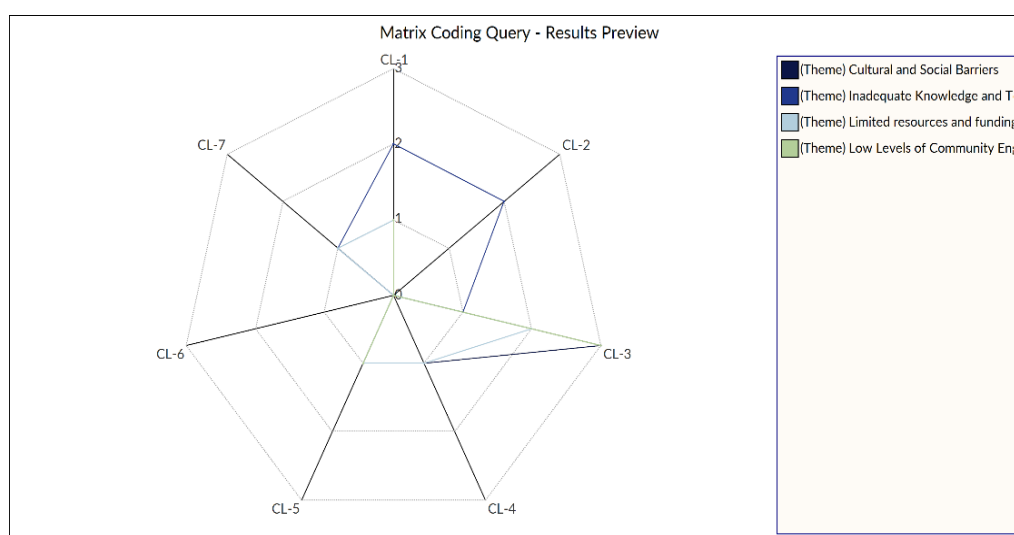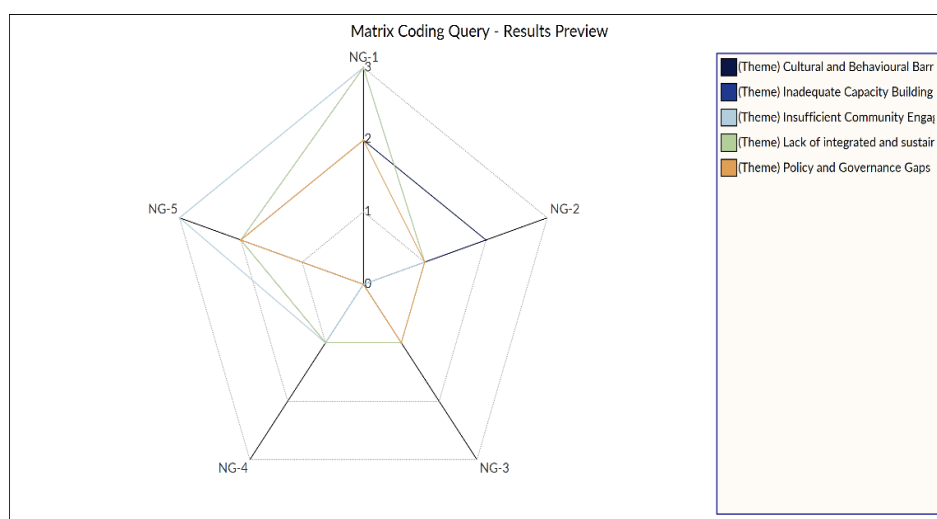

Figure 5: Matrix Coding Analysis of FGD with Community Leaders
Source: Author's Analysis in QSR Nvivo, 2024

Theme 5: Institutional and Policy Gaps
A recurring theme, particularly in the discussions with NGO members (Figure 6), public officers, and academics, was the persistent gap between policy formulation and implementation. Participants noted that while there are policies and strategic frameworks for flood management at both the state and national levels, these are often not effectively translated into action at the local level. One NGO participant observed, *"We have many good policies on paper, but when it comes to putting them into practice, there is little follow-up or accountability."* This disconnect has limited local institutions' ability to respond proactively to flood risks.

Public officers also acknowledged that coordination challenges among government agencies impede effective policy enforcement. As one public officer explained, *"Sometimes, two or three ministries are working on similar issues without communicating. This duplication wastes resources and causes delays."* The absence of a clear institutional framework for collaboration was seen as a critical weakness that undermines efforts to build resilience at the community level. Academics emphasised that funding shortfalls and the lack of decentralised planning further exacerbate these gaps. One academic participant stated, *"Local governments are often left out of decision-making, yet they are closest to the people who suffer from floods. Without adequate funding and empowerment, implementation will always remain weak."*

Moreover, participants across several groups underscored the need for more inclusive governance structures that genuinely integrate local communities into decision-making processes. While public officers recognised the value of community engagement, they admitted that policy approaches remain largely top-down, sidelining traditional institutions and indigenous knowledge systems that could enhance adaptive capacity.

Figure 6: Matrix Coding Analysis of FGD with NGO Members
Source: Author's Analysis in QSR Nvivo, 2024

Challenges Across Groups in the Flood Adaptation Practices
The five FGDs provide a nuanced understanding of the challenges associated with community-oriented flood adaptation across the five groups in the Ringim area, Jigawa State. Each group acknowledged the need for better adaptation measures. For example, community leaders and NGO members identified socio-economic factors, such as poverty, lack of education, and inadequate infrastructure, as substantial obstacles to effective flood management. Public officers and academics, on the other hand, emphasised the institutional and policy-related challenges, such as the lack of coordination between government agencies and the absence of integrated flood management policies. Professionals noted the technical and financial constraints that limit the construction and maintenance of flood defences, such as dikes and drainage systems. Next, the absence of effective early warning systems was highlighted as a significant gap in existing flood adaptation strategies. Community leaders and NGO members emphasised the importance of involving the local population in decision-making, noting that community participation could significantly enhance the effectiveness of any flood adaptation framework.

All the participants in the study highlighted several successful community-led initiatives that could inform future adaptation efforts. For example, community leaders shared how they utilised localised flood response mechanisms, such as traditional sand walls, water diversion methods, and collective labour to clear drainage channels, although these efforts need external support to scale. The NGOs also reported some success in awareness-raising programs and capacity-building workshops, but noted that funding constraints limit their ability to reach a broader audience. Public officers cited improvements in infrastructure maintenance and policy formulation, though they acknowledged that implementation at the local level remains weak.

All groups agreed that the lack of integration between traditional and modern approaches is a significant gap. Community members rely heavily on local knowledge, while external stakeholders tend to favour modern, often top-down solutions. There was consensus that a hybrid approach, combining community knowledge with modern technologies such as early warning systems and improved infrastructure, would be more effective. NGO members and academics both emphasized the need for long-term planning, noting that most interventions are reactive rather than proactive. Public officers noted that monitoring and evaluation of flood adaptation strategies are often neglected, leading to a lack of data on what works and what doesn't. Participants also highlighted a disconnect between policy formulation and implementation, noting that policies developed at the state or national level often do not translate effectively into local action.

While there was broad agreement on many issues, some differences in perspectives emerged. Community leaders placed a stronger emphasis on social and cultural barriers to adaptation, such as the reluctance of some groups to

adopt new practices. Professionals and public officers, however, focused more on the technical and logistical challenges, including the limited capacity of local governments to support large-scale infrastructure projects.

Academics tend to emphasise the need for more research and data-driven approaches, particularly in understanding the long-term impacts of climate change on flood patterns. In contrast, NGOs were more focused on immediate, actionable interventions, such as expanding community awareness programs and strengthening local committees.

It is evident from combining the themes from the FGDs that an extensive CBA framework should account for both structural and sociocultural elements. Enhancing funding channels, developing early warning systems and infrastructure, encouraging community involvement, and coordinating adaptation plans with regional cultural customs are all examples of this. The long-term sustainability and resilience of flood adaptation efforts also depend on strengthening local capacities and reforming governance frameworks.

In summary, triangulating findings from five FGDs with community leaders, NGO members, public officers, professionals, and academics provides a holistic understanding of the current state of flood adaptation in Ringim, Jigawa State. The FGDs revealed key insights into the challenges, existing strategies, and opportunities for enhancing community resilience to floods in the semi-arid region. By comparing and synthesising responses across these diverse groups, common themes were identified and areas where perspectives converge or diverge were pinpointed. The FGDs focused on addressing socioeconomic and cultural barriers to flood adaptation, improving early warning systems, and increasing community involvement (Figure 7). To increase the study area's resilience to flooding, the conversation emphasised the significance of targeted support systems and infrastructure upgrades.
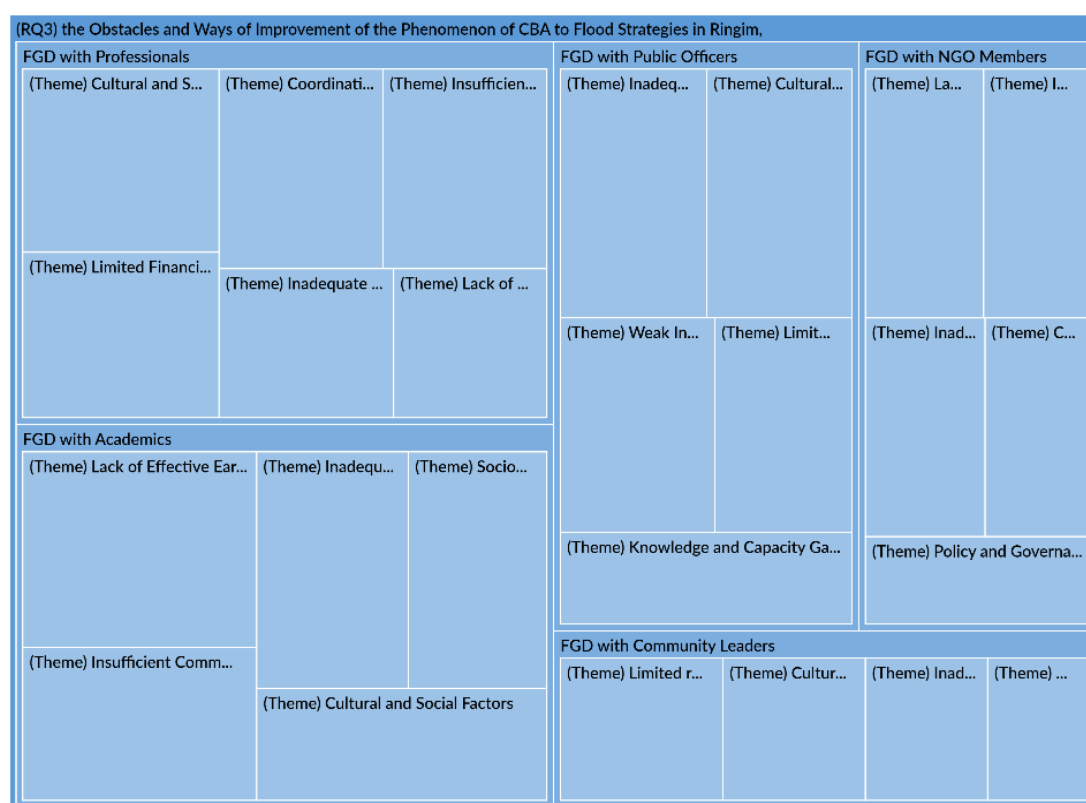
Figure 7: Hierarchy Charts of Codes for the Five FGDs
Source: Author's Analysis in QSR NVivo, 2024

Constructing the Framework
The insights from the FGDs contributed directly to the development of the proposed CBA framework. The emphasis on local committees, early warning systems, and community engagement in the framework reflects the priorities voiced by community leaders and NGO members. Meanwhile, the inclusion of capacity building, infrastructure maintenance, and policy integration addresses the concerns raised by public officers, professionals, and academics.

The multi-layered framework (combining community-led interventions with external support from government, NGOs, and professionals) aims to bridge the gap between the community's needs and the resources available to external actors. It also seeks to address the institutional and policy-related challenges identified in the FGDs by advocating stronger monitoring and evaluation mechanisms and the integration of policies across all levels of governance. Thus, based on the triangulation of the thematic analysis, a CBA framework for flood management was developed. The framework integrates the key themes identified from the FGDs and suggests specific roles for various stakeholders in enhancing flood resilience.

The Proposed Framework
This study aims to develop a comprehensive community-based framework to strengthen short- and long-term resilience to flooding. This is achieved by incorporating local knowledge, raising awareness, improving socio-economic conditions, and addressing governance challenges (see Figure 8 below). The framework has several layers to illustrate the relationship between the various agencies: the cover layer, the first outer layer, the second layer and finally the third layer.

The cover layer represents community engagement and ownership. At the heart of the framework lies the community itself, emphasising the importance of local ownership in flood adaptation. Local committees, knowledge sharing, and active participation are central to community-driven resilience, ensuring that the community is not just a passive recipient of external aid but actively contributes to adaptation strategies.

The first outer layer involves community-led interventions. This layer highlights community-driven activities, including early warning systems, weather alerts, and knowledge-sharing initiatives. These actions are designed to build local resilience by enabling proactive measures through localised committees and community gatherings. Such measures help people to come together, share knowledge, and actively participate in flood risk management.

Next, the second layer of key adaptation strategies emphasises more structured strategic adaptation efforts. These include addressing social and cultural barriers, capacity building, maintaining infrastructure, and integrating policies. This layer bridges community efforts with broader institutional and infrastructural support, ensuring that sustainable resources and policy frameworks support community-led initiatives.

Lastly, the third layer illustrates the supporting stakeholders who provide guidance and ensure the project's success. It includes the government bodies, NGOs, environmental professionals, and academics. Their role is crucial for monitoring, evaluation, and policy formulation. These stakeholders provide guidance, resources, and expertise to support and sustain the community's adaptation efforts, ensuring alignment with broader policy goals.

The proposed framework situates community resilience as its central tenet, amalgamating the initiatives of local stakeholders with auxiliary support systems. It outlines a clear pathway to enhance adaptive capacity while ensuring community members' active involvement in all adaptation initiatives. By integrating community stewardship, policy alignment, and technical acumen, this framework presents a comprehensive strategy for flood adaptation in Ringim and analogous semi-arid locales.
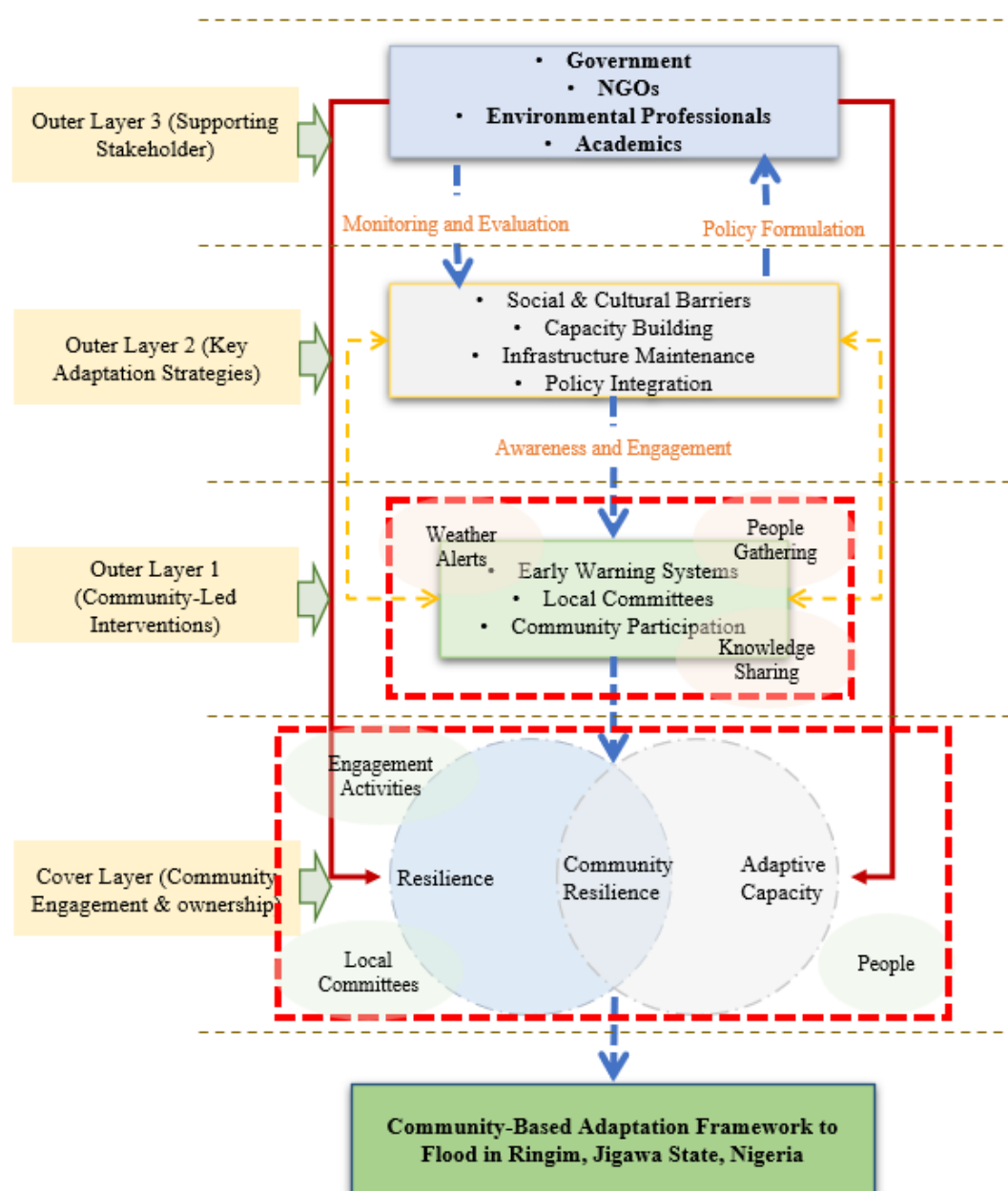
Figure 8: The proposed CBA Framework for Flood in Ringim
Source: Authors Analysis, 2024

DISCUSSION

The proposed CBA framework for floods in Ringim, Jigawa State, offers a structured, multi-layered approach that builds on existing practices while addressing significant gaps. By incorporating insights from local community leaders, public officers, NGO members, professionals, and academics, this framework aims to strengthen resilience and adaptive capacity in a region where floods continue to pose severe challenges.

A notable deficiency in the preliminary examination of results lies in the synthesis of the comprehensive qualitative data from the five FGDs involving community leaders, NGO representatives, professionals, public officials, and academics. These heterogeneous participant cohorts provided nuanced insights into the socio-cultural, institutional, and infrastructural dimensions of CBA in relation to flooding in the Ringim region. To derive substantial findings, it is imperative to amalgamate these viewpoints into broader thematic categories (such as governance, risk perception, traditional knowledge, institutional capacity, and infrastructure resilience). By undertaking such an endeavour, this study can more effectively elucidate patterns and correlations across stakeholder experiences, thereby facilitating a more profound understanding of shared challenges and localized

opportunities for adaptation. For example, recurring concerns regarding unreliable early warning systems and neglected drainage infrastructure, articulated by both community leaders and professionals, underscore systemic issues that transcend both grassroots and technical spheres. Likewise, the concordance between public officials and NGO representatives on the necessity of integrated policy support and community training exemplifies both institutional deficiencies and collaborative prospects. The synthesis of these perspectives strengthens the formulation of a more focused, contextually relevant adaptation framework.

The data from the FGDs have revealed several shortcomings in existing flood adaptation strategies, particularly in community engagement, infrastructure, and institutional support. The proposed framework enhances these areas by fostering greater collaboration between local actors and external stakeholders, integrating both traditional and modern approaches to adaptation. Eleven approaches have been identified for improving current practices using the framework.

First, it is strengthening early warning systems and local committees. Reliable early warning systems are essential for effective flood preparedness, but are often missing in Ringim. Studies by Oloruntoba et al. (2018), emphasise the importance of timely and accurate climate information for disaster management. The proposed framework places local committees at the core of disseminating alerts and coordinating responses, aligning with evidence from Gladfelter (2018), who highlights the role of participatory governance in effective disaster management. This formalisation of local committees ensures greater organisation and accountability, a significant improvement over the ad hoc responses currently observed.

Second is to address infrastructure gaps. Inadequate flood defences and poorly maintained drainage systems are recurring issues. The framework's emphasis on infrastructure maintenance and community monitoring reflects findings from Pandey (2019), who stresses the importance of integrating infrastructure resilience with community participation. By incorporating systematic maintenance programs, the framework moves beyond reactive measures to address long-term resilience needs.

Third, it is to enhance policy integration and capacity building. The framework ensures that adaptation strategies are embedded in local and national policies, addressing the lack of cohesion often cited in the literature, as in Manyena et al. (2019). Additionally, capacity-building initiatives, including training in climate-smart agriculture and flood preparedness, align with recommendations from Adger et al. (2005), who advocate for skill enhancement as a pillar of adaptive capacity.

Fourth, there are challenges in implementing the framework. While the framework offers significant improvements, several challenges may arise in its implementation. These include issues related to funding, cultural acceptance, and institutional coordination.

Fifth, it is the funding and resource allocation. Sustaining the proposed interventions requires financial backing, a challenge echoed by Eriksen et al. (2021), who note that resource scarcity often undermines adaptation efforts. Innovative funding mechanisms, such as public-private partnerships and international grants, must be explored to ensure successful implementation.

Sixth is the cultural barriers. Deeply rooted cultural practices may resist change, as noted by Few et al. (2021), who emphasise the need for culturally sensitive adaptation approaches. The framework promotes the integration of traditional knowledge alongside new strategies, fostering gradual community acceptance and ownership.

Seventh is the institutional coordination. Fragmented roles and responsibilities among government agencies often lead to inefficiencies. Dwirahmadi et al. (2023) stress that clear institutional roles and cross-agency collaboration are essential for effective governance, principles embedded in the proposed framework. The eighth is the comparison with existing models. The proposed framework builds on existing CBA models, tailoring them to the specific context of semi-arid regions, such as Ringim.

The ninth is the building on the CBA models. The framework aligns with established CBA principles, emphasising local knowledge and participatory governance (Ensor & Berger, 2009). However, it extends these models by incorporating formal institutional support and tailoring strategies to semi-arid contexts, addressing challenges like water scarcity and environmental degradation that are less pronounced in other regions. For example, in contrast to CBA models applied in the coastal areas, which often focus on protecting shorelines, this framework prioritises early warning systems and infrastructure maintenance to manage the unique flood risks associated with semi-arid regions. The focus on capacity building for sustainable agriculture also reflects the agricultural dependence of communities in Ringim, aligning adaptation strategies with local livelihoods.

The tenth is the comparison with ecosystem-based approaches. Ecosystem-based adaptation (EbA) models, which emphasise the role of ecosystems in reducing climate risks, often focus on restoring natural habitats, such as wetlands or forests, to absorb floodwaters. While EbA has proven successful in some regions, it may be less applicable in Ringim, where land degradation, drought and deforestation have already significantly reduced the ecosystem's natural flood defences (Abdullahi, 2020; Muhammad & Rilwanu, 2020). The proposed framework addresses this gap by integrating capacity building for land management and sustainable agriculture, recognising that environmental restoration must go hand in hand with socio-economic resilience in semi-arid regions.

Lastly, the eleventh is addressing gaps in existing strategies. Existing strategies are often piecemeal and lack an integrated approach. The holistic design of the proposed framework ensures synergy among its components, addressing gaps identified in earlier studies (Abdel-Mooty et al., 2021; Allan & Bryant, 2011; Bulti et al., 2019; Moser & Ekstrom, 2010; Nelson et al., 2007; Shammin et al., 2022). Connecting early warning systems, providing policy support, and fostering community engagement sets a new benchmark for comprehensive flood management in semi-arid regions.

CONCLUSION

This study makes a significant contribution by developing a CBA framework specifically tailored to the socio-economic and environmental challenges of flood management in semi-arid regions, with a focus on Ringim, Jigawa State. The proposed framework integrates local knowledge, community participation, and institutional support, providing a comprehensive approach that enhances resilience and reduces vulnerability to floods. Key elements, such as early warning systems, capacity building, policy integration, and infrastructure maintenance, empower communities to take proactive roles in managing flood risks. Meanwhile, external stakeholders provide crucial support in the formulation and monitoring of policies. This multi-layered framework is not only essential for Ringim but also applicable to other semi-arid regions facing similar climate challenges. As these areas increasingly face erratic rainfall and flooding, the framework provides a scalable model for enhancing resilience. By emphasising community ownership and institutional collaboration, it offers a context-specific solution that can be adapted to safeguard vulnerable populations and livelihoods in similar environments. This study emphasises the necessity for comprehensive, community-driven approaches to enhance flood resilience in semi-arid regions.

LIMITATIONS TO THE STUDY

This study is limited by its focus on a single semi-arid region, which may not fully represent conditions in other areas. Reliance on FGDs with a small participant group may not capture all community perspectives, and self-reported data may introduce bias. The framework has not been thoroughly tested in practice, so its effectiveness in real-world applications remains uncertain.

Another key limitation of this study is its reliance solely on data from five FGDs, which, while rich in qualitative insight, may not capture the full diversity of experiences across all flood-prone communities in Ringim or similar semi-arid regions. The purposive selection of participants (community leaders, NGO members, professionals, public officers, and academics) offers a valuable but potentially narrow perspective, as it excludes the voices of other vulnerable groups, such as women, youth, and persons with disabilities. Additionally, FGDs may be influenced by group dynamics, where dominant voices can overshadow minority opinions, limiting the depth and representativeness of the findings. The absence of quantitative data or broader geographic sampling further constrains the generalizability of the proposed framework beyond the immediate study area.

RECOMMENDATION TO THE STUDY

Based on the proposed CBA framework, several actionable recommendations are offered for policymakers, community leaders, and NGOs. Policymakers should integrate the framework into national and local disaster management policies, allocate sustainable funding for adaptation efforts, and ensure better inter-agency coordination for efficient implementation. Community leaders should formalise local flood response committees, engage community members in adaptation activities, and incorporate traditional knowledge into modern flood management strategies. NGOs and development agencies are encouraged to support capacity-building initiatives, provide financial and technical assistance for infrastructure development and maintenance, and advocate for the inclusion of CBA strategies in government policies. By fostering collaboration between these key actors, the framework can effectively enhance flood resilience in semi-arid regions like Ringim.

IMPLICATIONS OF THE STUDY

This study has significant implications for flood adaptation in semi-arid regions, such as Ringim. By proposing a CBA within the flood framework, it highlights the need to integrate local knowledge and socio-economic realities into formal adaptation policies, thereby supporting sustainable, widely accepted measures that reduce vulnerability. The proposed framework emphasises collaboration among community leaders, NGOs, and professionals to improve coordination for effective local adaptation. For policymakers and development agencies, the study offers a roadmap for targeted investments in capacity building and early warning systems. Its adaptable design also makes it applicable to similar regions, broadening its impact on resilience-building efforts.

For further studies, several key areas could be explored to enhance the understanding of CBA in semi-arid regions. Comparative studies between Ringim and other semi-arid areas could identify universally applicable components of the framework and those that require local customisation. Future research could also assess the economic viability of adaptation strategies, enabling policymakers to make informed decisions about resource allocation. Research on gender and social inclusion could examine how adaptation efforts impact different social groups, such as women and marginalised populations, fostering more inclusive policies. Exploring the integration of emerging technologies, such as mobile apps, into early warning mechanisms could enhance community participation and preparedness in flood-prone areas.

DECLARATION OF STATEMENT

We hereby declare that this research study is an original work completed as part of my academic research. All findings, analyses, and conclusions presented herein are based on primary data collected through focus group discussions with community leaders, NGO members, public officers, professionals, and academics, as well as secondary data obtained from relevant literature and studies on flood adaptation in semi-arid regions.

We affirm that this study has not been submitted to any other institution or organisation, nor has it been published in part or whole before this submission. The information presented accurately reflects the data gathered and the analysis conducted to understand and address the flood adaptation challenges facing semi-arid regions. Any references to other sources have been duly acknowledged in accordance with academic integrity standards.

ACKNOWLEDGEMENT

AUTHOR CONTRIBUTION

MMD was responsible for conceptualising the research, developing the methodology, conducting the FGDs, and preparing the original draft. SBM contributed to data curation, formal analysis, and visualization. SNHI validated the results and reviewed and edited the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefit, commercial, or financial conflicts and declare that there are no conflicts of interest with the funders.

REFERENCES

Abdel-Mooty, M. N., Yosri, A., El-Dakhakhni, W., & Coulibaly, P. (2021). Community flood resilience categorization framework. *International Journal of Disaster Risk Reduction*, *61*, 102349. https://doi.org/10.1016/j.ijdrr.2021.102349

Abdullahi, I. N. (2020). *The impact of climate change on the management and regeneration of parkland trees in the Savannah zones of Northern Nigeria*. An Unpublished PhD Thesis. Bangor University (United Kingdom). 28124423.

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change*, *15*(2), 77–86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Allan, P., & Bryant, M. (2011). Resilience as a framework for urbanism and recovery. *Journal of Landscape Architecture*, *6*(2), 34–45. https://doi.org/10.1080/18626033.2011.9723453

Ayers, J., & Forsyth, T. (2009). Community-based adaptation to climate change. *Environment: Science and Policy for Sustainable Development*, *51*(4), 22–31. https://doi.org/10.3200/ENV.51.4.22-31

Bahadur, A., Ibrahim, M., & Tanner, T. (2010). *The resilience renaissance? Unpacking of resilience for tackling climate change and disasters*. The Institute of Development Studies and Partner Organisations. Report. https://hdl.handle.net/20.500.12413/2368

Boafo, Y. A., Saito, O., Jasaw, G. S., Yiran, G. A. B., Lam, R. D., Mohan, G., & Kranjac-Berisavljevic, G. (2020). Perceived community resilience to floods and droughts induced by climate change in semi-arid Ghana. *Sustainability Challenges in Sub-Saharan Africa I: Continental Perspectives and Insights from Western and Central Africa*, 191–219. https://doi.org/10.1007/978-981-15-4458-3_6

Bolan, S., Padhye, L. P., Jasemizad, T., Govarthanan, M., Karmegam, N., Wijesekara, H., Amarasiri, D., Hou, D., Zhou, P., & Biswal, B. K. (2023). Impacts of climate change on the fate of contaminants through extreme weather events. *Science of The Total Environment*, 168388. https://doi.org/10.1016/j.scitotenv.2023.168388

Braun, V., & Clarke, V. (2022). Conceptual and design thinking for thematic analysis. *Qualitative Psychology*, *9*(1), 3. https://doi.org/10.1037/qup0000196

Bulti, D. T., Girma, B., & Megento, T. L. (2019). Community Flood Resilience Assessment Frameworks: A Review. *SN Applied Sciences*, *1*, 1–17. https://doi.org/10.1007/s42452-019-1731-6

Cantelmi, R., Di Gravio, G., & Patriarca, R. (2021). Reviewing qualitative research approaches in the context of critical infrastructure resilience. *Environment Systems and Decisions*, *41*(3), 341–376. https://doi.org/10.1007/s10669-020-09795-8

Cartwright, E., & Igudia, E. (2023). The case for mixed methods research: Embracing qualitative research to understand the (informal) economy. *Review of Development Economics*. *Review of Development Economics*, *28*(4), 1947-1970. https://doi.org/10.1111/rode.13069

Christou, P. A. (2022). How to Use Thematic Analysis in Qualitative Research. *Journal of Qualitative Research In Tourism*, *3*(2), 79–95. https://doi.org/10.4337/jqrt.2023.0006

Cutter, S. L., Emrich, C. T., Morath, D. P., & Dunning, C. M. (2013). Integrating social vulnerability into federal flood risk management planning. *Journal of Flood Risk Management*, *6*(4), 332–344. https://doi.org/10.1111/jfr3.12018

Dorroh, Z., Sanchez, J. N., & Ristow, B. (2025). Through Malaysian Eyes: A Qualitative Study of Local Perspectives on Expatriate Adjustment in Malaysia. *Malaysian Journal of Qualitative Research*, *11*(1). https://doi.org/10.61211/mjqr110105

Dwirahmadi, F., Barnes, P., Wibowo, A., Amri, A., & Chu, C. (2023). Linking disaster disk reduction and climate change adaptation through collaborative governance: Experience from urban flooding in Jakarta. *Geosciences*, *13*(11), 353. https://doi.org/10.3390/geosciences13110353

Ensor, J., & Berger, R. (2009). Community-based adaptation and culture in theory and practice. *Adapting to Climate Change: Thresholds, Values, Governance*, 227–239.

Eriksen, S., Schipper, E. L. F., Scoville-Simonds, M., Vincent, K., Adam, H. N., Brooks, N., Harding, B., Lenaerts, L., Liverman, D., & Mills-Novoa, M. (2021). Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance or irrelevance? *World Development*, *141*, 105383. https://doi.org/10.1016/j.worlddev.2020.105383

Few, R., Morchain, D., Spear, D., Mensah, A., & Bendapudi, R. (2017). Transformation, adaptation and development: Relating concepts to practice. *Palgrave Communications*, *3*(1), 1–9. https://doi.org/10.1057/palcomms.2017.92

Few, R., Spear, D., Singh, C., Tebboth, M. G. L., Davies, J. E., & Thompson-Hall, M. C. (2021). Culture as a Mediator of climate change adaptation: Neither static nor unidirectional. *Wiley Interdisciplinary Reviews: Climate Change*, *12*(1), e687. https://doi.org/10.1002/wcc.687

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society*, *15*(4), 20-43. https://www.jstor.org/stable/26268226

Gladfelter, S. (2018). The politics of participation in community-based early warning systems: Building resilience or precarity through local roles in disseminating disaster information? *International Journal of Disaster Risk Reduction*, *30*, 120–131. https://doi.org/10.1016/j.ijdrr.2018.02.022

Hadlos, A., Opdyke, A., & Hadigheh, S. A. (2022). Where does local and indigenous knowledge in disaster risk reduction go from here? A systematic literature review. *International Journal of Disaster Risk Reduction*, *79*, 103160. https://doi.org/10.1016/j.ijdrr.2022.103160

Kantoush, S. A., Saber, M., Abdel-Fattah, M., & Sumi, T. (2022). Integrated strategies for the management of wadi flash floods in the Middle East and North Africa (MENA) Arid Zones: The ISFF Project. *Wadi Flash Floods: Challenges and Advanced Approaches for Disaster Risk Reduction*, 3–34. https://doi.org/10.1007/978-981-16-2904-4_1

Khan, A., Haslan, R. H., & Ramos, H. M. (2025). Navigating through work post-pandemic - experiences of middle-income employees in Malaysia. *The Malaysian Journal of Qualitative Research*, *11(1) May 2025*, 31. https://doi.org/10.61211/mjqr110103

Khan, N. A., & Abedin, S. (2022). Focus group discussion. In *Principles of Social Research Methodology* (pp. 377–387). Springer. https://doi.org/10.1007/978-981-19-5441-2_26

Lawal, A. T., Barau, S. S., & Umoru, G. I. (2020). Resources use efficiency of Garden egg (Solanum melongena) Production in Ringim Local Government Area of Jigawa State, Nigeria. *Journal of Community & Communication Research*, *5*(1), 184–189. https://jccr.sccdr.org.ng/

Mairiga, N. M., & Ibrahim, M. (2021). Assessment of indigenous knowledge in managing environmental challenges: A case study of Ringim local government area of Jigawa state, Nigeria. *International Journal Of Scientific Advances*, *2*(4). https://doi.org/10.51542/ijscia.v2i4.25

Manyena, B., Machingura, F., & O'Keefe, P. (2019). Disaster Resilience Integrated Framework for Transformation (DRIFT): A new approach to theorising and operationalising resilience. *World Development*, *123*, 104587. https://doi.org/10.1016/j.worlddev.2019.06.011

Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences*, *107*(51), 22026–22031. https://doi.org/10.1073/pnas.1007887107

Muhammad, I., & Rilwanu, Y. (2020). Effects of flood on environmental quality in Ringim, Jigawa State, Northern Nigeria. *International Journal Of Science For Global Sustainability (IJSGS)*, *6*(3), 33–44.

Nabinejad, S., & Schüttrumpf, H. (2023). Flood risk management in arid and semi-arid areas: A comprehensive review of challenges, needs, and opportunities. *Water*, *15*(17), 3113. https://doi.org/10.3390/w15173113

Ndlovu, E., Prinsloo, B., & Le Roux, T. (2020). Impact of climate change and variability on traditional farming systems: Farmers' perceptions from south-west, semi-arid Zimbabwe. *Jàmbá: Journal of Disaster Risk Studies*, *12*(1), 1–19. https://hdl.handle.net/10520/ejc-jemba-v12-n1-a9

Nelson, D. R., Adger, W. N., & Brown, K. (2007). Adaptation to environmental change: contributions of a resilience framework. *Annu. Rev. Environ. Resour.*, *32*(1), 395–419. https://doi.org/10.1146/annurev.energy.32.051807.090348

Oloruntoba, R., Sridharan, R., & Davison, G. (2018). A proposed framework of key activities and processes in the preparedness and recovery phases of disaster management. *Disasters*, *42*(3), 541–570. https://doi.org/10.1111/disa.12268

Pandey, C. L. (2019). Making Communities Disaster Resilient: Challenges and Prospects for Community Engagement in Nepal. *Disaster Prevention and Management: An International Journal*, *28*(1), 106–118. https://doi.org/10.1108/DPM-05-2018-0156

Reid, H. (2014). A natural focus for community-based adaptation. *Community-Based Adaptation to Climate Change: Emerging Lessons. Practical Action Publishing, Rugby*, 35–54.

Reid, H. (2016). Ecosystem-and community-based adaptation: learning from community-based natural resource management. *Climate and Development*, *8*(1), 4–9. https://doi.org/10.1080/17565529.2015.1034233

Reid, H., & Huq, S. (2014). Mainstreaming community-based adaptation into national and local planning. In *Climate and Development* (Vol. 6, Issue 4, pp. 291–292). Taylor & Francis. https://doi.org/10.1080/17565529.2014.973720

Rezaei-Sadr, H., & Eslamian, S. (2022). Arid zone flooding. In *Flood Handbook* (pp. 81–110). CRC Press. https://doi.org/10.1201/9781003262640

Schipper, E. L., Ayers, J., Reid, H., Huq, S., & Rahman, A. (2014). *Community-based adaptation to climate change: Scaling it up*. Routledge.

Shammin, M. R., Haque, A. K. E., & Faisal, I. M. (2022). A framework for climate-resilient community-based adaptation. *Climate Change and Community Resilience*, 11–30. https://doi.org/10.1007/978-981-16-0680-9_2

Soares, M. de O., Campos, C. C., Carneiro, P. B. M., Barroso, H. S., Marins, R. V., Teixeira, C. E. P., Menezes, M. O. B., Pinheiro, L. de S., Viana, M. B., & Feitosa, C. V. (2021). Challenges and Perspectives for the Brazilian Semi-Arid Coast under Global Environmental Changes. *Perspectives in Ecology and Conservation*, *19*(3), 267–278. https://doi.org/10.1016/j.pecon.2021.06.001

Spires, M., Shackleton, S., & Cundill, G. (2014). Barriers to implementing planned community-based adaptation in developing countries: A systematic literature review. *Climate and Development*, *6*(3), 277–287. https://doi.org/10.1080/17565529.2014.886995

Thomas, D. S. G., & Twyman, C. (2005). Equity and justice in climate change adaptation amongst natural-resource-dependent societies. *Global Environmental Change*, *15*(2), 115–124. https://doi.org/10.1016/j.gloenvcha.2004.10.001

Wilby, R. L., & Keenan, R. (2012). Adapting to flood risk under climate change. *Progress in Physical Geography*, *36*(3), 348–378. https://doi.org/10.1177/0309133312438908