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Socio-Cultural Dimensions Of Community Engagement And Flood Risk Awareness In Semi-Arid Ringim, Jigawa State, Nigeria

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ABSTRACT

Flooding in semi-arid regions, such as Ringim, Jigawa State, Nigeria, remains a persistent hazard, necessitating heightened community engagement and awareness to reduce vulnerability and strengthen resilience. Despite the increasing focus on Community-Based Adaptation (CBA) strategies, there is a critical gap in the literature regarding the specific ways semi-arid communities engage with flood risks. Previous research has largely neglected the localised socio-cultural and institutional barriers that hinder effective community engagement and flood risk awareness in these contexts. Guided by social learning theory and participatory risk governance, the study examines how community engagement processes shape flood risk awareness and adaptive responses in the semi-arid context of Ringim. Using a qualitative method approach, including interviews, Focus Group Discussions (FGD), and participant observations, the study explores the community's perceptions, attitudes, and behaviours toward flood hazards. It examines the role of information sources, educational programs, and previous experiences in shaping the community's engagement with flood risks. Data were analysed using open and axial coding in QSR NVivo to generate codes and themes that reveal both the strengths and deficiencies in current community practices and knowledge. The study makes a significant contribution to the field by addressing the underexplored dynamics of flood risk awareness in semi-arid environments. It bridges the gap between existing CBA frameworks and the realities of local engagement, offering actionable recommendations to improve flood risk communication, foster community ownership, and integrate indigenous knowledge with formal flood adaptation strategies. The research provides recommendations for enhancing community resilience to floods, particularly in vulnerable semi-arid regions, thus filling an essential void in current flood adaptation literature. Future research could expand on this study by comparing flood risk awareness and adaptation strategies in different semi-arid regions with similar socio-economic and climatic conditions.

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1. Introduction

Flooding presents a substantial danger to societies inhabiting semi-arid regions across the globe. The adverse consequences of flooding, which include harm to property, loss of lives, and disruption of vital services, necessitate the active involvement and enlightenment of the affected societies (Li & Lin, 2023; Shakeri et al., 2021). The involvement and awareness of the community play

pivotal roles in mitigating flood risks and fostering resilience (Mai et al., 2020). Although flooding in semi-arid regions is often framed as a primarily hydrological challenge, the situation in Ringim, Jigawa State, is shaped by distinct socio-cultural and institutional constraints, including strong traditional authority structures, gendered participation norms, and deeply rooted beliefs that influence risk perception and response. These factors are compounded by weak institutional coordination, limited state presence, and low trust in formal flood management interventions, which collectively constrain effective community engagement and flood risk reduction in Ringim. This study aims to examine and evaluate the level of community engagement and awareness concerning flood hazards in Ringim. By delving into the community's understanding, attitudes, and actions regarding flood hazards, this study aspires to contribute to the existing literature on community engagement and strategies for managing flood risks.

In recent times, Ringim and its neighbouring societies have witnessed recurring instances of flooding, resulting in devastating consequences for the local population. While flooding in semi-arid regions is globally associated with episodic intense rainfall, poor drainage, and fragile ecosystems (Rabelo et.al., 2023), these challenges manifest differently in Ringim due to localised socio-cultural and institutional conditions. In Ringim, flood risk is mediated by strong traditional leadership hierarchies, culturally embedded perceptions of flooding as a natural or divinely determined event, gendered norms that limit inclusive participation, and weak institutional capacity for enforcement and coordination, all of which shape how communities perceive, prepare for, and respond to flood hazards.
The impacts of flooding surpass immediate physical damage, leading to social, economic, and environmental repercussions that impede community development (de Bruijn et al., 2022; Mashi et al., 2020). Therefore, there is an urgent requirement to comprehensively comprehend the level of community participation and awareness regarding flood hazards in Ringim and devise effective strategies for flood risk mitigation.

This research holds significance as it addresses the critical gap in knowledge concerning community engagement and awareness of flood hazards in semi-arid regions. By focusing on Ringim, this study will provide valuable insights and recommendations that can potentially be applied to other similar regions grappling with comparable challenges. The findings of this study will not only benefit the local population of Ringim but also serve as a foundation for developing CBA strategies for managing flood risks.

By comprehending the community's perceptions and actions on flood risks, effective strategies for community engagement and awareness can be formulated to mitigate these risks. Despite their typically low and erratic rainfall, semi-arid regions like Ringim in Jigawa State are paradoxically prone to flooding. This is due to a combination of factors such as poor drainage infrastructure, increasing surface runoff from intense but short-lived rains, land degradation, and climate variability. These regions experience a delicate ecological balance, with limited vegetation cover and fragile soils that exacerbate the impact of sudden rainfall events, making them particularly vulnerable to flash floods. Flooding in semi-arid regions such as Ringim threatens livelihoods, infrastructure, and social well-being. In this study, community refers to the residents of Ringim who share a geographic space, social ties, and common exposure to flood hazards; engagement denotes their active participation in planning and action for flood preparedness and response; awareness reflects their knowledge and understanding of flood hazards; and risk refers to the potential for loss or disruption from flooding. Engagement and awareness shape how residents perceive flood risks and influence their willingness to adopt preventive measures, as active involvement fosters a sense of responsibility and readiness, while greater awareness improves accurate risk assessment and informed decision-making.

In this study, community engagement and awareness are shown to play a critical role in shaping how residents of Ringim perceive and respond to flood risks. Active participation in dialogues, participatory mapping, and consultations with local leaders enables residents to share lived experiences, identify vulnerable areas, and collectively develop preventive strategies, fostering a sense of ownership that enhances the likelihood of sustained action. Awareness efforts, including early warning messages, sensitisation campaigns, and educational outreach, strengthen understanding of both the likelihood and potential severity of floods, encouraging timely and informed responses. As engagement deepens, awareness moves beyond the passive receipt of information to the internalisation of its relevance in everyday decision-making, shifting perceptions of flooding from an inevitable natural occurrence to a manageable risk. This transformation encourages proactive measures such as drainage maintenance, timely evacuation, and adoption of resilient building practices.

This study is conceptually anchored in social learning theory and participatory risk governance, which frame community engagement as a critical pathway through which flood risk awareness is produced, negotiated, and translated into collective action, particularly within socio-culturally structured and institutionally constrained semi-arid communities such as Ringim. Furthermore, by aligning modern flood management approaches with traditional practices and local norms, engagement and awareness reduce resistance to change, bridging the gap between indigenous knowledge and contemporary adaptation strategies. In doing so, they not only elevate community preparedness but also promote a proactive culture of flood risk reduction.

2. Literature Review

2.1 Community-Based Flood Adaptation in Nigeria's Semi-Arid Regions

Flood vulnerability in Nigeria's semi-arid northern regions, particularly Jigawa, Katsina, and Yobe states, has escalated due to seasonal rainfall variability, land degradation, and weak urban planning (Mashi et al., 2020; Zakaria et al., 2021). Although these regions are typically associated with water scarcity, flash floods now frequently occur, overwhelming infrastructure and displacing households. In these contexts, community-based adaptation (CBA) has emerged as a viable strategy for strengthening

resilience through the inclusion of local knowledge and practices (Yusuf et al., 2021).

However, implementation remains uneven. Oyediran and Wahab (2023) observed that despite basic awareness of flood risks in Kebbi State, public engagement in risk reduction was minimal due to poor institutional communication. Similarly, Zakaria et al. (2021) noted that while assessments of flood risk factors in Jigawa led to structural recommendations (e.g., embankments and water outlets), these often lacked community input and ownership.

2.2 Socio-Cultural Dynamics and Flood Adaptation

Flood risk perception and adaptation in northern Nigeria are closely tied to socio-cultural structures. In Ringim and similar Hausa communities, traditional leadership, patriarchal norms, and religious beliefs significantly shape engagement (Buba et al., 2021). Men, especially community and religious leaders, typically control decision-making processes in land use and disaster planning. Consequently, women and youth are frequently excluded from formal risk management conversations despite their informal roles in early warning dissemination and response (Abubakar et al., 2021).

Religious interpretations also affect adaptation behaviour. For many, floods are seen as divine acts or spiritual retribution, which may lead to fatalism and reduce proactive risk reduction behaviours (Yusuf et al., 2021; Ibrahim et al., 2023). However, these same belief systems, if aligned with Islamic environmental ethics, can enhance community mobilisation when leveraged through trusted religious leaders.

Additionally, traditional systems such as gayya (communal labour) and indigenous forecasting methods based on environmental cues remain relevant but underutilised in formal planning (Baba et al., 2022). These socio-cultural dimensions are essential for building effective, locally grounded adaptation strategies.

2.3 Knowledge, Perception, and Preparedness

Flood risk awareness is often shaped by prior experience and socio-demographic factors. Sin-Ampol et al. (2020) found that individuals with direct flood experience tend to be more prepared. In Nigeria, Obi et al. (2021) and Yusuf et al. (2021) showed that education, income level, and access to early warning systems influence how households respond to floods. However, Franceschinis et al. (2021) warned that overreliance on government infrastructure can result in a false sense of security and reduced community initiative.

Zakaria et al. (2021) highlighted further barriers such as language gaps, low literacy, and inadequate translation of technical data, all of which limit effective communication of flood risks in rural northern communities.

2.4 Community Engagement Frameworks and Their Limitations

Despite national and international calls for participatory approaches, most flood interventions in Nigeria adopt top-down frameworks that overlook local governance systems (Atanga, 2020). There is limited integration of Hausa cultural structures, such as ward heads (hakimai), Imams, youth associations, and women's groups, into formal disaster risk management. This disconnect weakens trust and limits long-term adaptation (Loudyi et al., 2022).

Although participatory frameworks like Community-Based Risk Reduction (CBRR) and Participatory Rural Appraisal (PRA) have been employed elsewhere in Africa (Dufty, 2017; Matczak & Hegger, 2021), they are seldom adapted to Hausa sociopolitical contexts. Baba et al. (2022) emphasise that many projects in northern Nigeria stop at the awareness phase and lack sustained community feedback mechanisms or co-management structures.

2.5 Conceptual Relationship between Community Engagement and Flood Risk Awareness

In this study, community engagement and flood risk awareness are treated as interrelated but sequential concepts. Engagement is understood as the initial process through which communities interact with information sources, local institutions, and decision-making structures related to flood risk (Li et.al.,2023), thereby creating opportunities for learning and knowledge exchange. Flood risk awareness emerges from this engagement, as repeated participation, dialogue, and exposure to shared experiences shape how risks are perceived, interpreted, and acted upon. At the same time, increased awareness reinforces further engagement by motivating proactive participation in adaptation activities, indicating a dynamic and iterative relationship rather than a linear one.

2.6 Theoretical Framework: Linking Community Engagement, Awareness, and Flood Risk

This study is underpinned by Social Learning Theory and Participatory Risk Governance, which together provide a framework for understanding how community engagement and flood risk awareness interact to shape risk perception and adaptive behaviour. Social Learning Theory posits that individuals develop knowledge and awareness through interaction, shared experiences, and collective reflection, rather than through isolated information dissemination (Rachmand 2025). In flood-prone contexts such as Ringim, repeated engagement in community discussions, traditional leadership forums, and informal collective actions enables residents to interpret flood experiences, exchange indigenous knowledge, and construct shared understandings of risk.

Participatory Risk Governance complements this perspective by emphasising the role of inclusive decision-making, institutional trust, and stakeholder collaboration in effective risk management (Okada et.al., 2018). Within this framework, community engagement functions as the primary mechanism through which awareness of flood hazards is generated and sustained, while heightened awareness, in turn, motivates participation in preparedness and adaptation measures. Flood risk is therefore not merely a physical hazard but a socially constructed phenomenon influenced by cultural beliefs, power relations, and access to information. By integrating these theoretical lenses, the study establishes a coherent conceptual link between engagement, awareness, and risk, directly informing the research design, data analysis, and interpretation of findings.

2.7 Theoretical Sequencing of Community Engagement and Flood Risk Awareness

This study is grounded in Social Learning Theory and Participatory Risk Governance, which together provide a conceptual basis for understanding the relationship between community engagement and flood risk awareness. Within this framework, community engagement precedes and facilitates awareness, as participation in collective discussions, decision-making processes, and interactions with local institutions enables the exchange of knowledge, experiences, and interpretations of flood risks. Through engagement, individuals are exposed to shared narratives, traditional knowledge, and institutional information, which collectively shape their understanding of flood hazards.

Flood risk awareness, in turn, evolves as an outcome of sustained engagement and functions as a reinforcing mechanism that motivates continued participation in adaptation and preparedness activities (Lin 2023). As awareness increases, communities become more likely to question existing practices, adopt preventive measures, and demand institutional support, thereby deepening engagement. This reciprocal and iterative relationship aligns with social learning processes, where knowledge acquisition, reflection, and action continuously inform one another, rather than operating as linear or isolated stages.

3. Methodology

3.1 Description of the Study Area

Ringim LGA, located in Jigawa State, Nigeria, is situated in the northwestern part of the state, covering an area of approximately 1057 square kilometres and precisely positioned at coordinates 12°17°N:9°28°E and 12.283°N:9.467°E. This region is inhabited by an estimated population of 257,100 individuals (Mairiga & Ibrahim, 2021). The study was carried out in Gabarin (Latitude 12.096271° and Longitude 9.162209°), a suburban area (Figure 1) of Ringim in Jigawa State, Nigeria. This particular state is positioned in the North-western region of the nation, encompassing latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E. Jigawa State spans an approximate land area of 22,410 square kilometres and comprises 27 LGAs (National Population Commission (NPC) & National Bureau of Statistics (NBS), 2016). The climatic conditions in Ringim are categorised as semi-arid, characterised by alternating dry and wet seasons from May to September (Lawal et al., 2020). According to the Jigawa State Diary (2015), the topography of the region is characterised by elevated land areas, reaching heights of up to 750 meters above sea level. The soil composition varies from sandy to loamy and is generally fertile, with numerous sections of Fadama and alluvial plains.

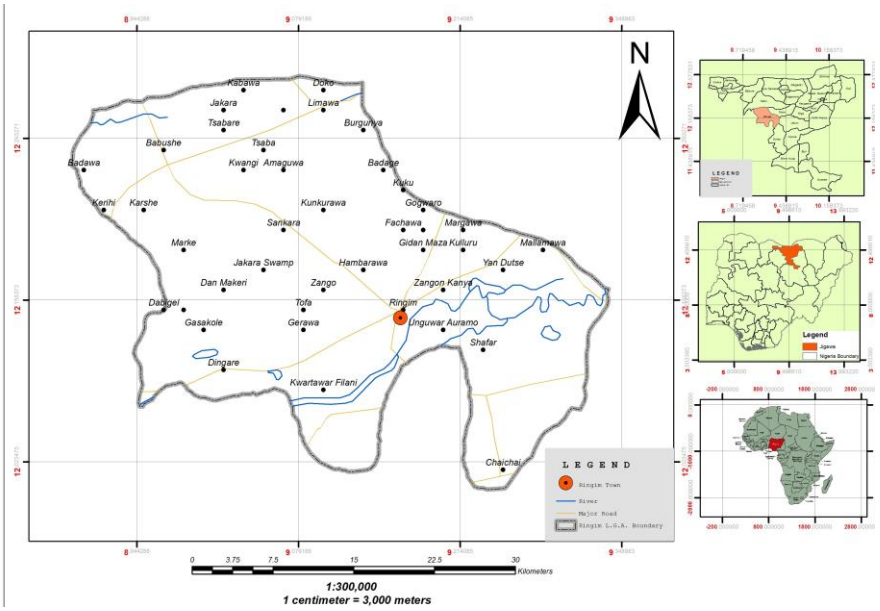

Figure 1 Site location Imagery of Ringim (Author's Analysis in ArcGIS, 2024)

The state experiences two distinct seasons, namely the rainy season, which extends from June to October, and the dry season, which spans from November to May. The average temperature ranges from 35°c in October to approximately 50°c in May, while the mean annual rainfall varies between 700 mm and over 1000 mm, with some lowland areas experiencing rainfall for up to 200 days (Diary, 2015). The months of November to March are particularly cold (hamattan) due to the dry northeast wind. The Hadejia and Katagum rivers are the primary water sources for irrigation activities within the state (Aga, 2009). Notably, the Hadejia-Nguru River boasts the largest Fadama area in Nigeria.

The selection of Ringim is justified by its increasing exposure to flood risks despite being located in a semi-arid ecological zone. Although Jigawa is traditionally characterised by low rainfall and drought-prone conditions, the area has witnessed a rise in seasonal flash floods due to erratic rainfall, poor drainage infrastructure, and land-use changes. Ringim, in particular, has experienced recurrent flooding that affects livelihoods, damages infrastructure,

and displaces residents, making it a critical site for examining flood risk awareness and adaptation. Moreover, Ringim represents a typical semi-urban northern Nigerian community with strong socio-cultural systems (such as traditional leadership hierarchies, Islamic religious structures, and defined gender roles) that significantly influence how information is shared and how communities respond to environmental threats. These dynamics offer a rich context for investigating how cultural beliefs, social hierarchies, and local governance affect flood preparedness and engagement.

3.2 Data Collection

The research implemented a qualitative approach to data collection through the use of interviews, FGD and participant observations. This selection has been made due to the inherent qualities of these methods, which enable the researcher to conduct a systematic inquiry and derive meaningful interpretations from the gathered information (Johnson et al., 2020). Moreover, these approaches are well-suited for obtaining factual insights into the experiences, beliefs, and emotions of local individuals within specific professions, activities, and services (Knott et al., 2022; Mack & Woodsong, 2005). The formulation of the questions in this study was deliberately structured to provide participants with sufficient flexibility and autonomy to express their views, lived experiences, and perceptions in their own words. Open-ended and non-leading questions were employed to encourage in-depth responses, allowing informants to reflect on personal experiences of flooding, community engagement practices, and socio-cultural influences without constraint, thereby enhancing the richness and authenticity of the data collected.

In this particular study, a purposive sampling technique was employed to enhance the reliability of the investigation (Mweshi & Sakyi, 2020). Purposive sampling was used to select participants with direct experience and contextual knowledge of flooding in Ringim. Selection prioritised diversity in age, gender, occupation, education, and length of residency to ensure information-rich perspectives relevant to community engagement, socio-cultural dynamics, and flood risk awareness. Furthermore, the research successfully captured the gestures, reactions, and expressions of the informants, as well as any other non-verbal cues, through the utilisation of face-to-face interactions (Hadley et al., 2022). This methodology led to the acquisition of a precise understanding of the informants' thoughts and reactions (Barton, 2015). Interviews and FGD were conducted with individuals ranging from 45 to 65 years old. The research gathered data from significant and sensitive locations such as residences, marketplaces, village squares, and the like. These movements also help in the rich documentation of observations by the researchers. An unstructured questionnaire was utilised as a tool during the FGD and interviews, encompassing pertinent inquiries on engagement and awareness about flood risks and CBA strategies within the study's designated area. A single FGD was conducted with seven purposively selected community leaders in Ringim LGA, chosen for their knowledge of local flood experiences and socio-cultural practices. Held after initial interviews, the session used a semi-structured guide to facilitate discussion while allowing participants to elaborate on perceptions and adaptation strategies. The discussion was audio-recorded, transcribed, and thematically coded, with findings triangulated against interview and observational data to validate and enrich the results. The assistance of indigenous resource persons, who served as research assistants, was necessary for the completion of this research. The study engaged two indigenous resource persons as research assistants, selected based on their familiarity with the Ringim community, fluency in local languages, and prior experience in field data collection. They were tasked with facilitating interviews and FGDs, assisting with participant recruitment, and ensuring accurate transcription of responses. Each assistant was remunerated according to local standard rates for fieldwork, reflecting the time and effort required for data collection and verification. This provision afforded a peaceful opportunity for informants to express their varying opinions with ease.

Field-based qualitative research in flood-prone regions such as Ringim is often constrained by seasonal accessibility, unpredictable weather, and community sensitivities, which can affect participant availability and the depth of data collected. In this study, these contextual challenges were managed through flexible scheduling, engagement of local research assistants, and reliance on trusted community leaders to facilitate access and participation.

This study adopts Social Learning Theory and Participatory Risk Governance as guiding frameworks for both data collection and analysis. These perspectives informed the design of interview and FGD questions by emphasising participation, collective learning, trust, and interaction between community members and institutions. They also guided the analytical process in NVivo, where codes related to engagement (e.g., participation, leadership, and institutional interaction) were examined alongside awareness-related codes (e.g., risk perception, preparedness, and adaptive practices), allowing the study to systematically explore how learning and awareness emerge through participatory processes.

3.2.1 Demographic Attributes of the Informants

The demographic profile of the urban dwellers and community leaders (Table 1) engaged in this study reveals a predominantly male group with significant ties to their communities, as many have lived in their respective areas since birth. Of the 30 informants, 27 are male, and 3 are female. Most informants are farmers (12) and traders (6), indicating that agriculture and commerce are the dominant occupations within this community. Educational qualifications vary, with some having non-formal education (7), while others possess secondary education (9), primary education (6), or higher qualifications such as degrees and diplomas (8). The majority of informants are married (24), with a few being single (5) or divorced/widowed (2). A total of 30 informants were purposively selected for the semi-structured interviews to obtain a broad and insightful understanding of flood risk awareness and community engagement in Ringim, Jigawa State. The number was guided by the need to achieve thematic saturation, a point in qualitative research where additional interviews yield no new information. This sample size also allowed for the inclusion of informants from different social,

economic, gender, and age groups, thereby capturing a wide range of perspectives. Informants were chosen based on their direct experience with flooding, their role in informal or formal community responses, or their local influence, ensuring that the voices included were both relevant and diverse. The selection aimed to reflect the socio-cultural complexity of the study area and to explore how different community members perceive and respond to flood risks within a semi-arid, culturally rooted context.

The data collection involved interviews with all informants, while a subset of informants (7) also participated in Focus Group Discussions (FGDs), highlighting their active engagement in the study. This demographic diversity offers insights into the various perspectives and lived experiences of flood risk awareness and adaptation within this community. Previous studies have indicated that gender and age play a significant role in determining human vulnerability to natural hazards, particularly floods (Ahmad & Afzal, 2020; Dintwa et al., 2019; Hamidazada et al., 2019; Naz & Saqib, 2021; Pathak et al., 2020). Therefore, considering that the majority of the informants were in their middle and active age brackets, it is likely that they exhibited certain physical, psychological, social, and economic conditions that enhanced their ability to cope with flood hazards.

Table 1 The demographic characteristics of the informants involved in the study

Participant	Gender	Age	Occupation	Qualification	Marital Status	Interview	FGD	Years of Residency
1	Male	63	Farmer	Non-formal	Married	✓		Since birth
2	Male	61	Farmer	Secondary	Married	✓		Since birth
3	Male	63	Farmer	Non-formal	Married	✓	✓	Since birth
4	Male	52	Trader	Secondary	Married	✓		45
5	Male	54	Teacher	Degree	Married	✓		Since birth
6	Male	60	Farmer	Primary	Married	✓	✓	40
7	Male	58	Farmer	Non-formal	Married	✓	✓	45
8	Male	50	Trader	Secondary	Married	✓		Since birth
9	Male	62	Farmer	Non-formal	Widowed	✓	✓	50
10	Female	46	Civil Servant	Degree	Single	✓		30
11	Male	50	Farmer	Primary	Married	✓		35
12	Male	45	Teacher	Degree	Married	✓		30
13	Female	45	Teacher	Degree	Single	✓		28
14	Male	56	Farmer	Secondary	Divorced	✓	✓	40
15	Male	50	Civil Servant	Diploma	Married	✓		35
16	Male	56	Farner	Nom-formal	Single	✓		Since birth
17	Male	60	Trader	Primary	Married	✓	✓	45
18	Male	56	Farmer	Primary	Married	✓		Since birth
19	Male	52	Farmer	Secondary	Married	✓		38
20	Male	48	Civil Servant	Degree	Single	✓		24
21	Male	54	Farner	Non-formal	Married	✓		40
22	Male	56	Farner	Non-formal	Married	✓		40
23	Male	63	Artisan	Secondary	Married	✓	✓	45
24	Male	33	Trader	Secondary	Single	✓		Since birth
25	Male	29	Civil Servant	Higher Diploma	Single	✓		Since birth
26	Female	34	Housewife	Primary	Married	✓		Since birth
27	Male	18	Trader	Secondary	Single	✓		Since birth
28	Male	28	Trader	Secondary	Single	✓		18
29	Female	36	Housewife	Primary	Married	✓		Since birth
30	Male	61	Farmer	Primary	Married	✓		47

Source: Author's Fieldwork, 2024

3.3 Method of Data Analysis

Data analysis in this research was conducted using a qualitative thematic approach, supported by NVivo software for systematic coding and interpretation. Primary data were collected through semi-structured interviews, focus group discussions (FGDs) with key stakeholders, and participatory observation of flood-prone areas and community practices in Ringim. The collected data were transcribed and imported into QSR NVivo, where open and axial coding were applied to identify recurring themes, patterns, and socio-cultural dimensions influencing community engagement and flood risk awareness. These themes were organised around pre-established codes. The use of NVivo's matrix coding queries and visualisation tools (e.g., hierarchy charts and coding intersections) allowed for a nuanced exploration of how these socio-cultural factors intersect and shape adaptive behaviours. This analytical approach ensured that the voices of community members were meaningfully interpreted within their cultural and

environmental context, providing a grounded understanding of community-based flood resilience in semi-arid Ringim.

4. Results

4.1 Thematic Analysis of the findings gathered from the Interviews and FGDs

The thematic analysis approach encompasses the procedure of discerning, scrutinising, and documenting codes that are categorised in the form of recurring patterns or themes within qualitative data (Labra et al., 2020; Lester et al., 2020). To be efficient in this practice, a researcher must be deeply engaged, think creatively and reflexively about the data, and go beyond the most obvious or surface-level interpretations of the data through an intensive and organic coding process (Braun & Clarke, 2023). Regarding the research question and objectives concerning community involvement, awareness, and flood-hazard adaptation strategies in Ringim, Jigawa State, Nigeria, the following codes and themes surfaced (Table 2) for the interviews as a result of the open coding and thematic analysis of the data in QSR NVivo.

4.1.1 Data Coding and Theme Development

All interview transcripts, FGD records, and participant observation notes were imported into NVivo for systematic qualitative analysis. An initial round of open coding was conducted to identify recurring concepts related to flood experiences, community engagement, awareness, and socio-cultural practices. These codes were then refined through axial coding, where related codes were grouped into broader categories based on conceptual similarity and relevance to the study objectives. In QSR NVivo analysis, the Files column identifies the original data sources from which coded segments are drawn and provides direct access to their contextual location within the source documents. The References column indicates the number of coded segments linked to each file or code, offering a quantitative indication of how frequently specific themes appear and supporting comparative analysis as shown in Tables 2 and 3.

Finally, thematic coding was applied to generate overarching themes by examining patterns, convergence, and divergence across data sources, thereby ensuring that the themes were grounded in participants' narratives and supported by triangulated evidence.

Table 2 Overview of the codes and themes emanated from the thematic analysis of the interviews

S/N	Codes	References	Files	Themes
1	Participation in Decision-Making	7	7	Community Engagement
2	Involvement in Community Initiatives	30	50	
3	Community Education and Awareness Programs	26	26	
4	Knowledge of Flood Risks	29	52	Awareness and Perception
5	Perceived Severity and Vulnerability	29	32	
6	Attitude towards Flood Risk	10	14	
7	Traditional Practices	17	21	Flood Adaptation Strategies
8	Modern Adaptation Initiatives	23	30	
9	Challenges Faced in Implementation	6	7	
10	Collaborative Efforts	30	67	Collaborative Efforts and Vision
11	Future Vision and Aspirations	14	15	
12	Socio-economic Factors	26	30	Socio-Economic and Environmental Context
13	Environmental Consideration	20	20	

Source: Author's Analysis in QSR Nvivo, 2024

4.2 Analysis of the Interviews

The analysis of interviews with urban dwellers and community leaders revealed key themes that highlight the community's engagement, awareness, and strategies toward flood risk. One significant theme is Community Engagement, with codes like "Participation in Decision-Making" and "Involvement in Community Initiatives." These codes emphasise the degree of participation urban dwellers have in local decision-making processes and their active involvement in initiatives addressing flood risks. The data suggests that while community engagement exists, there is room for improvement in integrating more voices into these initiatives.

Another major theme is Awareness and Perception of flood risks. Codes such as "Knowledge of Flood Risks," "Perceived Severity and Vulnerability," and "Attitude towards Flood Risk" indicate a strong understanding of the dangers posed by flooding. However, attitudes toward these risks vary, with some displaying complacency despite awareness. This theme also highlights the perceived vulnerability of the community and their concern about the increasing severity of floods.

The theme of Flood Adaptation Strategies focuses on the community's reliance on both "Traditional Practices" and "Modern Adaptation Initiatives." While traditional methods, such as using local knowledge to predict flood patterns, remain vital, there is a shift toward modern strategies like flood-resistant

infrastructure. Yet, challenges such as inadequate resources hinder the full implementation of these initiatives.

Collaborative Efforts and Vision emerged as another key theme, highlighted by the frequent references to "Collaborative Efforts" among community members, government bodies, and NGOs. This underscores the importance of collective action in mitigating flood risks. Furthermore, "Future Vision and Aspirations" reflect the community's hopes for more sustainable flood management systems in the future.

Lastly, the theme of Socio-Economic and Environmental Context is underscored by codes related to "Socio-economic Factors" and "Environmental Consideration." These reflect the broader challenges the community faces, includiSng economic limitations and the need to address environmental degradation, which exacerbate the impacts of flooding. This theme shows the interplay between socio-economic conditions and environmental factors in shaping the community's vulnerability and capacity to adapt to floods.

The data underwent additional scrutiny and examination utilising QSR Nvivo via sophisticated methodologies, including word frequency analysis (Figure 2), which elucidated the most frequently employed terminology and expressions within the interviews, thereby illuminating persistent apprehensions or focal points in the community's dialogue concerning flood-related issues.

Figure 2 Word Frequency of Interviewees' Responses **(**Author's Analysis in QSR Nvivo, 2024**)**

Matrix coding queries were utilised to investigate the correlations among various themes and the demographic characteristics of the informants (Figure 3), thereby facilitating a more profound comprehension of how variables such as age, employment status, or duration of residency impact perceptions and behaviours on flood risks.

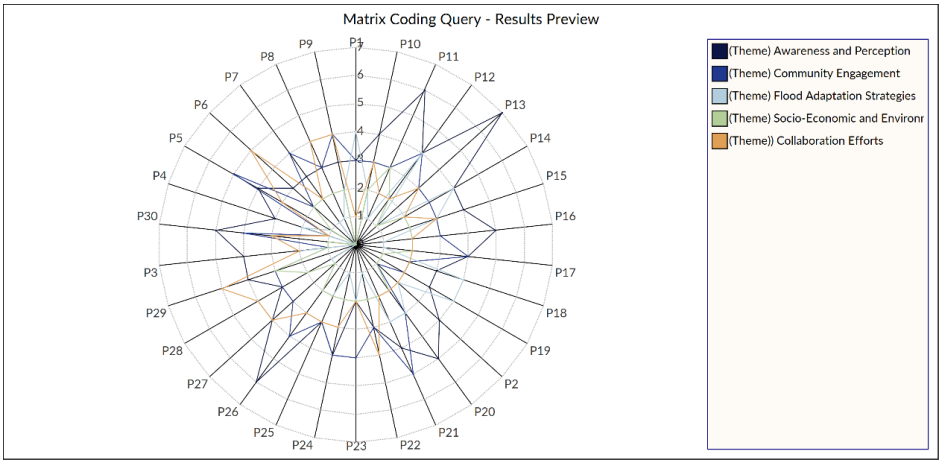

Figure 3 Radar Chart Matrix Coding Query (Author's Analysis in QSR Nvivo, 2024)

Moreover, hierarchical diagrams were employed to graphically illustrate the significance and frequency of each theme within the dataset (Figure 4), thereby providing a readily comprehensible summary of the issues that predominantly influenced the discourse.

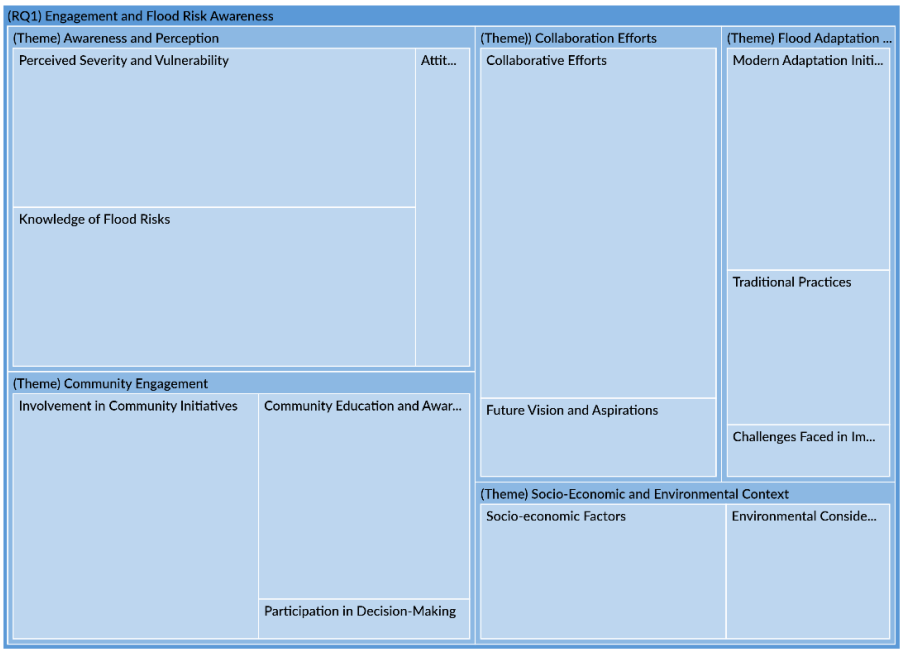

Figure 4 Hierarchy Charts of Codes and Themes (Author's Analysis in QSR NVivo, 2024)

The amalgamation of these analytical instruments enabled a thorough examination of the dataset, yielding a resilient and profound interpretation of the community's cognisance, methodologies, and obstacles in addressing the persistent issue of flooding. The application of QSR Nvivo not only supported the structured evaluation of extensive qualitative data but also guaranteed that the themes were firmly rooted in the perspectives of the informants, thereby rendering the findings representative of the authentic experiences and practices within the designated study area.

4.4 Analysis of the Focus Group Discussion

This FGD was conducted in Gabarin of Ringim, Jigawa State, Nigeria, to assess the level of community engagement and awareness regarding flood risks and CBA strategies. The FGD aimed to explore the existing adaptation strategies, as well as the knowledge, attitudes, and perceptions of the community towards flood risks in the semi-arid region. The FGD was conducted with 7 community members, including local leaders and stakeholders involved in flood risk management. The session involved an open and structured discussion guided by the research objectives and questions. The informants were encouraged to share their experiences, insights, and perspectives.

Table 3 Overview of the codes and themes emanated from the thematic analysis of the FGD with Community Leaders

S/N	Codes	Files	References	Theme
1	Inconsistent financial support	1	2	Limited resources and funding
2	Dependence on external aid	1	6	
3	Lack of technical training	1	4	Inadequate knowledge and technical expertise
4	Limited access to information	1	2	
5	Resistance to change	1	3	
6	Social hierarchies limiting participation.	1	4	Cultural and social barriers
7	Lack of awareness campaigns	1	3	Low level of community engagement and participation
8	Minimal involvement in planning	1	2	

Source: Author's Analysis in QSR Nvivo, 2024

The FGD with community leaders revealed several critical themes and codes reflecting the challenges and limitations faced by the community in managing flood risks. (Table 3).

The first theme, Limited Resources and Funding, is highlighted by the codes "Inconsistent financial support" and "Dependence on external aid." These reflect the community's heavy reliance on unpredictable funding sources and external assistance for flood adaptation initiatives. The inconsistency in financial resources hampers the sustainability of community-based adaptation strategies and leaves the community vulnerable during emergencies.

The theme of Inadequate Knowledge and Technical Expertise is reflected in the codes "Lack of technical training" and "Limited access to information." Community leaders expressed concerns over the lack of technical skills and the limited availability of reliable information on flood risk management. This inadequacy reduces their ability to implement modern adaptation strategies, leaving them dependent on outdated practices.

Cultural and Social Barriers emerged as another significant theme, with codes such as "Resistance to change" and "Social hierarchies limiting participation." These illustrate the social dynamics that hinder collective action and acceptance of new flood mitigation strategies. Resistance to adopting new technologies or methods, combined with entrenched social hierarchies, prevents equitable participation and limits the effectiveness of community initiatives.

The theme of Low Levels of Community Engagement and Participation is represented by the codes "Lack of awareness campaigns" and "Minimal involvement in planning." These indicate that despite the risks posed by flooding, there is limited effort to raise awareness or actively involve the community in planning processes. The minimal involvement of community members in decision-making further exacerbates their vulnerability and weakens the overall flood resilience efforts in the area.

Together, these themes illustrate the multifaceted challenges of flood adaptation in urban areas, from financial and technical limitations to cultural and social obstacles, underscoring the need for more inclusive, well-supported strategies.

The analysis of word frequency yielded a concise overview of the terminology that is recurrently employed by members of the community, as represented through a word cloud (Figure 5). This representational visualisation underscores the principal concepts and issues articulated during the discourse, thereby providing valuable insights into the community's priorities and contextualising their collective comprehension of the challenges and methodologies pertinent to flood management. In sum, the thematic framework and the corresponding analyses accentuate the community's collaborative ethos and mutual dedication to formulating effective strategies for adaptation in response to flooding.

Figure 5 Word Frequency of FGD with Community Leaders (Author's Analysis in QSR Nvivo, 2024)

The matrix coding depicted in Figure 6 exemplifies that the aggregated perspectives of community leaders are uniformly allocated across the delineated themes. This allocation implies a certain level of homogeneity among the informants, signifying a mutual comprehension and a collective orientation concerning their opinions on adaptation strategies.

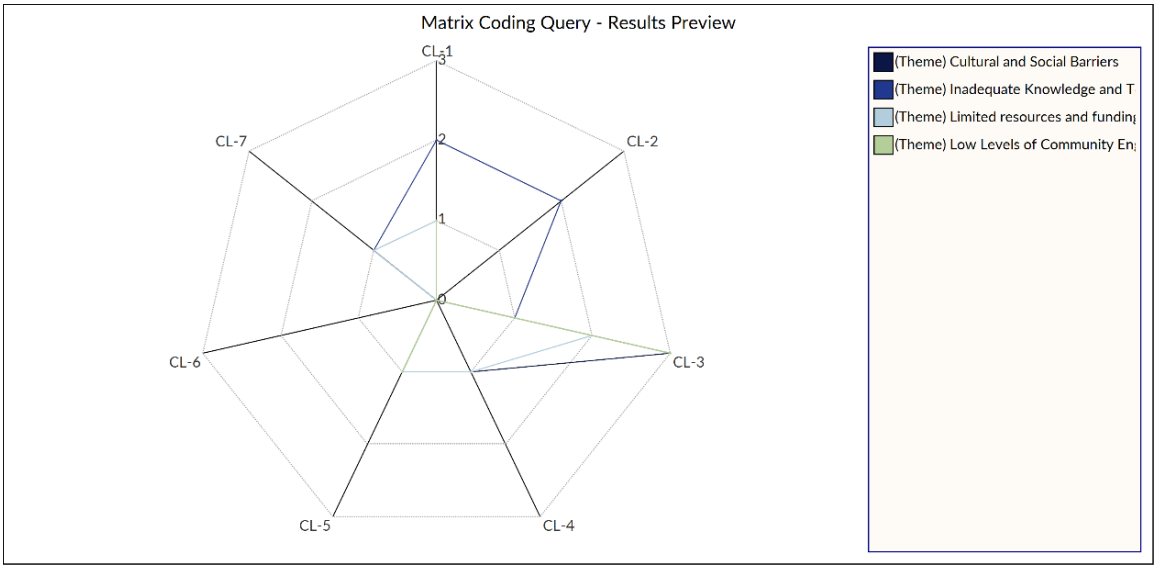

Figure 6 Radar Chart Matrix for FGD with Community Leaders (Author's Analysis in QSR Nvivo, 2024)

To highlight the common language and concepts used by the community when discussing their experiences and flood adaptation strategies, Figure 7 summarises the recurring codes found during the conversations with community leaders.

Figure 7 Hierarchical Charts of Codes for FGD with Community Leaders (Author's Analysis in QSR Nvivo, 2024)

4.4 Participant Observation

The participant observation in the study was conducted in Gabarin, a semi-arid region in the Ringim local government area of Jigawa State, Nigeria. The study employed a participant observation approach as an addition to the interviews and FGD, which involved the researcher immersing themselves within the community to gain firsthand experiential knowledge of the community's engagement with flood risks and adaptation strategies. Data collection occurred for a spread of 12 months.

The analysis of photos taken during participatory observation revealed key insights into the community's response to floods and the challenges they face. These findings are categorised into several themes, illustrating the community's resilience,

vulnerabilities, and the impact of floods on their livelihoods and infrastructure.

The theme of Community-led Interventions is highlighted through codes like "Community-built barriers" and "Local collective action." These reflect the proactive steps taken by the community to mitigate flood risks through locally organised efforts, such as constructing makeshift barriers and pooling resources for collective action (Figure 8). These interventions, though limited in scope, demonstrate the community's willingness to address the issue independently, especially in the absence of sustained external support.

The theme of Effect on Livelihoods is evident from observations of "Disrupted agriculture" and "Damaged businesses." The photos show the significant toll that flooding takes on agricultural lands and small businesses, which are vital to the community's economy (Figure 9). Crops are destroyed, and markets or shops are damaged, exacerbating poverty and food insecurity in the area.

Figure 8 In between the sand walls serving as the entrance to Gabarin (Authors' Fieldwork 2023)

Figure 9 Sandbags to divert the flow of water (Authors' Fieldwork 2023)

Figure 10 Use of Sandbags to augment potholes on the road at low levels(Authors' Fieldwork 2023)

Figure 11 Ponds for the supply of sharp sand and water storage disrupting natural drainage systems (Authors' Fieldwork 2023)

Flood-prone areas are another theme that emerged from images capturing "Low-lying regions" and "Areas near rivers." These regions are consistently vulnerable to flooding due to their geographical positioning. The photographs underline how these areas, being the most affected, face recurring challenges that further strain community resources and resilience (Figure 10).

The theme of Natural Water Drainage is captured by codes such as "Blocked drainage channels" and "Erosion of natural waterways." Blocked drainage and soil erosion from waterways compromise the natural flow of water, worsening flood conditions. The photos highlight the need for better maintenance of natural drainage systems to prevent severe flooding during heavy rainfall (Figure 11).

Land Use Patterns is a theme reflected in "Construction on floodplains" and "Agricultural expansion." The images reveal that unregulated construction and agricultural activities in flood-prone areas have exacerbated the flood risks. Expanding farmlands and building homes on floodplains disrupt the natural landscape, making the community more susceptible to flooding.

Existing Practices and Government and NGO Support are also central themes. Photos of "Traditional methods" and "Use of natural barriers" depict the community's reliance on indigenous knowledge for flood prevention. In contrast, limited "Flood prevention infrastructure" and "Relief materials" provided by the government and NGOs suggest that while external support exists,

it remains insufficient to meet the growing needs of the community.

Lastly, the Effect on Housing and Infrastructure is dramatically shown in images of "Submerged houses" and "Destroyed roads and bridges." These photos document the widespread devastation caused by floods, highlighting the pressing need for improved housing designs and stronger infrastructure to withstand flood impacts.

To enhance the comprehension of the visual data, a variety of analytical methodologies were utilised, encompassing word frequency analysis, matrix coding, and hierarchical charting. The word frequency analysis facilitates the aggregation of a compendium of the terms that manifest with the greatest regularity during the examination of photographs obtained from fieldwork and participatory observation (Figure 12). The Word Frequency analysis enumerates the predominant lexicon or concepts present within the data.

Figure 12 Word Frequency of Analysis of Photos during Participatory Observation (Author's Analysis in QSR Nvivo, 2024)

The Radar chart matrix coding inquiries about the 36 scrutinised photographs (Figure 13) facilitate the elucidation of intersections between the encoded images and the emergent themes, thereby providing profound insights into the alignment or divergence of each image with various thematic patterns. This figure graphically illustrates the adaptation strategies employed by the community, as inferred from the content of the photographs analysed during the fieldwork.

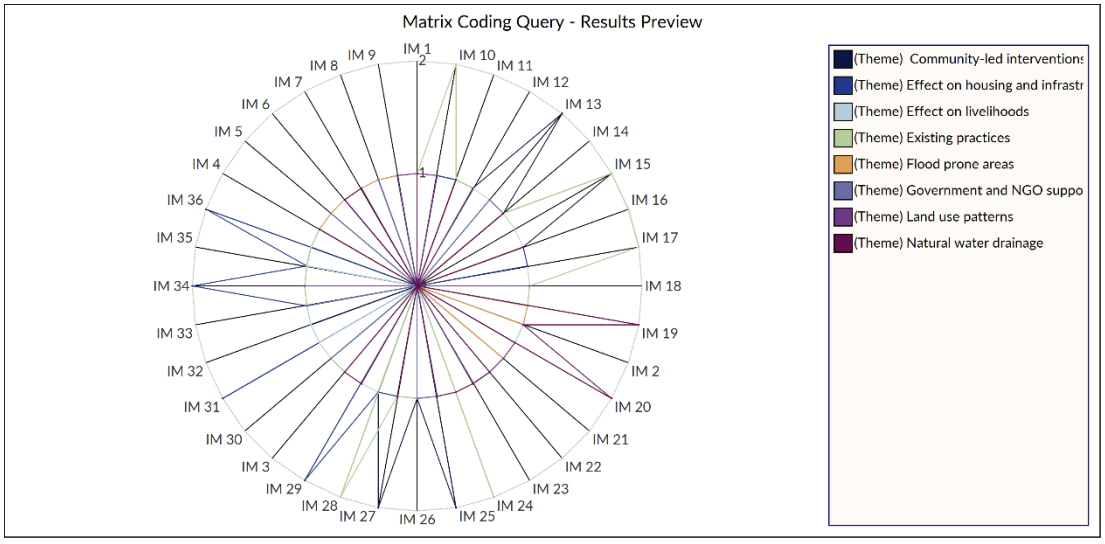

Figure 13 Radar Chart Matrix for Photos from Participatory Observation (Author's Analysis in QSR Nvivo, 2024)

The hierarchical chart serves as a visual representation of hierarchical data through a configuration of nested rectangles, wherein the dimensions of each rectangle are indicative of the relative importance of the data involved. In this context, the chart is employed to illustrate the volume of coding attributed to each category or code derived from the analysed photographs obtained

during the participatory observation (Figure 14), with larger rectangles signifying more frequently occurring or salient coding categories.

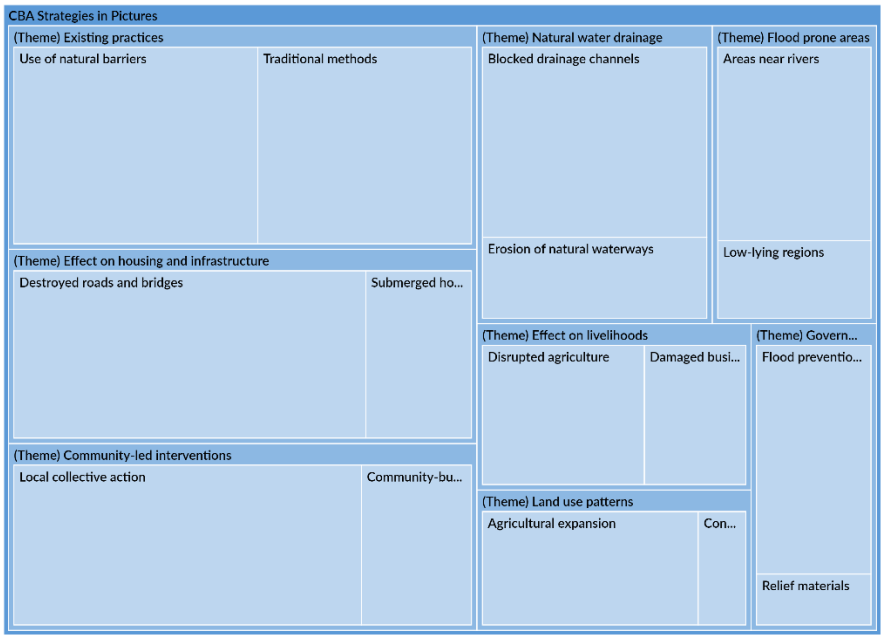

Figure 14 Hierarchy Charts of Codes for Photos from Participatory Observation (Author's Analysis in QSR Nvivo, 2024)

4.5 Triangulation Analysis of Codes and Themes for Interviews, FGD, and Participant Observation

This triangulation analysis synthesises findings from semi-structured interviews, the FGD with community leaders, and participatory observation to test the validity and reliability of the study's emergent themes. The convergence and divergence across these sources help to strengthen the interpretation of results and deepen the understanding of the socio-cultural dynamics of flood risk awareness and adaptation in Ringim, Jigawa State.

4.5.1 Community Engagement and Participation

Convergence was observed between the interviews and FGD, both identified limited formal community participation in flood-related planning and interventions. Interviewees cited a lack of invitation or empowerment, while the FGD stressed structural exclusion due to social hierarchies. Observation complemented these findings by documenting informal, reactive initiatives (e.g., ad hoc drain clearing), but no sustained or institutionalised community engagement processes. The triangulation of these sources validates the insight that while informal engagement exists, a significant gap remains in structured participation, particularly for marginalised groups. This convergence points to the need for participatory governance frameworks that can institutionalise local efforts.

4.5.2 Awareness and Perception of Flood Risks

The data sources also showed strong convergence on this theme. Interviews reflected varied levels of individual awareness, shaped by personal experience and access to information. The FGD supported this by identifying gaps in risk communication, particularly for vulnerable populations. Observational data further validated these concerns: despite visible signs of risk, blocked drains, and proximity of homes to waterways, there was little evidence of anticipatory action or shared community preparedness. This triangulated insight strengthens the interpretation that there is a disconnect between physical risk and perceived vulnerability, highlighting the urgency of localised, inclusive, and continuous awareness campaigns.

4.5.3 Flood Adaptation Strategies

Here, the triangulation reveals both complementarity and divergence. Interviews indicated a blended reliance on traditional strategies and occasional modern support, but noted financial and technical barriers. The FGD emphasised a dependency on external actors, such as the government or NGOs, and a lack of capacity-building initiatives. Observation validated the presence of community-led coping practices, but also revealed that many were reactive and unsustainable. While informants spoke of adaptation, what was observed were coping mechanisms, not long-term resilience strategies. This nuanced insight, supported by the triangulated data, suggests a misalignment between perception and practice and points to the need for integrated, community-driven adaptation support.

4.5.4 Socio-Economic and Cultural Barriers

Across all three sources, there was a high level of convergence regarding the role of socio-economic and cultural constraints. Both the interviews and FGD underscored how poverty, gender norms, and cultural beliefs inhibit full participation in adaptation

and decision-making. Observation confirmed the persistence of traditional, male-dominated structures and the absence of women and youth in public flood-related activities. This convergence reinforces the validity of the claim that culturally embedded inequalities hinder effective community engagement, and underlines the importance of context-sensitive adaptation frameworks that actively involve underrepresented groups.

4.5.5 Infrastructure and Governance Gaps

All three data sources aligned in identifying weak infrastructure and limited government presence as central issues exacerbating flood vulnerability. Interviews and the FGD described deteriorating infrastructure, unfulfilled promises of government aid, and a lack of coordinated governance mechanisms. Observations confirmed visible signs of infrastructural decay, such as damaged culverts, poorly maintained roads, and insufficient drainage. The strong convergence across methods validates the conclusion that flood risk is not merely environmental, but institutional, necessitating both physical investments and governance reforms to enhance community resilience.

4.5.6 Summary of Validity through Triangulation

This triangulated analysis confirms the internal consistency and credibility of the findings by demonstrating how insights from interviews, FGD, and observations mutually reinforce (in most cases), or reveal critical tensions (in some). Rather than presenting each source in isolation, the analysis tests whether data converge on common explanations or highlight gaps between perception, behaviour, and systemic support. This strengthens the trustworthiness of this study and ensures that its conclusions are grounded not just in anecdotal accounts but in cross-validated field evidence. Triangulating the findings from interviews, FGDs with community leaders, and participatory observation enabled the testing of validity through the convergence and divergence of information from multiple data sources. This approach ensured that themes were not only identified but also verified against different perspectives and contexts. The summary (Table 4) presents the main themes, the evidence from each method, and the analytical insights derived from their intersection.

Table 4 Triangulation Matrix of Themes Across Data Sources

Theme	Interviews	FGD	Observation	Triangulation Outcome
Community Engagement and Participation	Limited formal involvement; some informal local initiatives.	Exclusion due to social hierarchies; lack of invitation to participate.	Informal, reactive efforts observed; absence of formal structures.	Convergence – All sources point to informal participation but lack of structured, institutional engagement.
Awareness and Perception of Flood Risks	Varied individual awareness, shaped by personal experiences.	Gaps in awareness campaigns; barriers in communication.	Visible risks (e.g., blocked drains) but no proactive community action.	Convergence – Consistent evidence of a disconnect between physical risks and community perceptions.
Flood Adaptation Strategies	Mix of traditional and modern practices; resource limitations.	Reliance on aid; lack of technical training.	Community-led efforts are visible but largely reactive and unsustainable.	Complementarity with Divergence – All highlight adaptation, but divergence in perception (strategies vs coping mechanisms).
Socio-Economic and Cultural Barriers	Poverty, gender norms, and beliefs limit participation.	Social and cultural inequalities prevent wider engagement.	Male-dominated structures; absence of women/youth in adaptation activities.	Convergence – Strong agreement that socio-cultural and economic factors hinder adaptation.
Infrastructure and Governance Gaps	Weak infrastructure; limited government responsiveness.	Lack of coordinated governance; unmet promises of aid.	Physical signs of infrastructural decay: poor drainage maintenance.	Convergence – All sources reinforce that institutional and infrastructural weaknesses increase vulnerability.

Source: Author's Analysis in QSR Nvivo, 2024

5. Discussion

The findings align with social learning theory by demonstrating that flood risk awareness in Ringim is not solely the result of individual experience but is shaped through collective engagement, shared narratives, and interaction with traditional and institutional actors. However, where participatory spaces are limited by socio-cultural hierarchies, gender norms, or weak institutional coordination, learning processes are constrained, resulting in uneven awareness and fragmented adaptation practices. From a participatory risk governance perspective, the results reveal gaps between community-level engagement and formal flood management structures, underscoring how limited inclusion and weak governance interfaces undermine the translation of awareness into effective risk reduction. This study set out to examine and evaluate the level of community participation and awareness regarding flood hazards in the semi-arid region of Ringim LGA, Jigawa State, Nigeria. The triangulated analysis of interviews, an FGD with community leaders, and participatory observation provided a consistent and

validated picture of how the community perceives and responds to flood risks.

The convergence of findings revealed that while informal, self-organised actions such as clearing blocked drains and mobilising local resources do occur, these efforts are often fragmented and lack formal support structures. Low participation in structured flood preparedness activities was linked to limited awareness campaigns, socio-cultural barriers, and low trust in government interventions. Observation confirmed these trends, with visible evidence of flood risk—such as poor drainage maintenance—contrasting sharply with a lack of proactive community-wide action.

The findings also demonstrated that awareness of flood hazards is present but unevenly distributed across social groups, often influenced by traditional hierarchies, gender roles, and access to information. While community leaders recognise the threat posed by flooding, the absence of sustained institutional engagement limits their capacity to mobilise collective action.
Concerning the research objective, the analysis clearly shows that both community participation and awareness are insufficient to ensure effective local flood resilience. The triangulated approach strengthens the validity of this conclusion by showing alignment across all three data sources. These insights provide a strong basis for formulating targeted strategies that enhance awareness campaigns, improve participatory structures, and integrate informal community actions into formal disaster risk management frameworks; critical steps for mitigating flood risks in Ringim and similar semi-arid contexts.

These insights not only contribute to the existing body of literature on flood risk management in semi-arid regions but also highlight key gaps in current practices.

5.1 Community Engagement and Participation

Existing literature underscores the importance of community involvement in flood management, but this study shows that formal participation in decision-making is still lacking in Ringim. While community members engage in informal initiatives, participation in formal planning remains minimal. One participant noted, "*We are never really part of the planning. We just do what we can on our own*" (Interview, Participant 6). Social hierarchies, along with a lack of awareness campaigns, limit engagement. A community leader expressed, "*Only a few people are involved in meetings, and others don't even know what is happening*" (FGD, Community Leader 2). This highlights a gap in the literature, where community engagement models fail to account for socio-cultural dynamics. The study bridges this gap by calling for more inclusive engagement strategies that consider local hierarchies and power dynamics.

5.2 Awareness and Perception of Flood Risks

While previous studies stress the need for risk awareness to build resilience, the findings here indicate that awareness in Ringim does not always lead to action. Although informants are aware of the flood risks, many still underestimate their vulnerability. As one respondent put it, "*We know the floods can come, but we have lived with it for so long. We don't see it as something we can avoid*" (Interview, Participant 9). Additionally, the FGD revealed that access to reliable information is inconsistent, with one participant saying, "*Sometimes, we hear about the floods too late. We need better warnings, but they don't come*" (FGD, Community Leader 5). This disconnect between risk perception and preparedness shows a gap in the literature that overlooks how inconsistent communication affects local responses. The study fills this gap by advocating for better risk communication and tailored education programs to translate awareness into actionable preparedness.

5.3 Flood Adaptation Strategies

The literature on flood adaptation often emphasises modern technological solutions. However, this study reveals that communities in Ringim heavily rely on traditional methods, which are proving insufficient given the increasing frequency of floods. "*We still use sandbags and dig small trenches, but the floods are getting worse, and these don't always work anymore,*" one participant explained (Interview, Participant 17). Meanwhile, modern adaptation efforts are hindered by limited financial resources and a lack of technical knowledge. A participant from the FGD said, "*We don't have the money or skills for bigger projects, so we do what we can*" (FGD, Community Leader 1). This highlights a gap where existing literature overlooks the financial and technical constraints that prevent communities from adopting more resilient methods. The study contributes to the field by suggesting the integration of local knowledge with modern practices and stressing the need for capacity-building programs that address these limitations.

5.4 Socio-Economic and Cultural Barriers

This study highlights the socio-economic challenges that limit flood adaptation, such as low income, poor access to resources, and cultural resistance to change. One participant noted, "*We don't have the money to build anything strong enough to stop the water*" (Interview, Participant 19), while another added, "*People don't want to leave their homes, even when the government says it's dangerous*" (FGD, Community Leader 3). These barriers are consistent with the literature on flood adaptation in underdeveloped regions, but are compounded in Ringim by social hierarchies and gender dynamics that further limit participation. The study adds value by providing evidence that these barriers must be addressed in flood adaptation strategies, advocating for interventions that are not only technically sound but also culturally and economically viable.

5.5 Infrastructure and Governance Gaps

Previous studies emphasise the need for robust infrastructure to mitigate flood risks, but the findings here reveal that weak governance and sporadic support from the government and NGOs are equally to blame for the community's vulnerability. "*The drainage systems are blocked, and no one comes to fix them. After the floods, we don't see any officials until the next time it happens,*" one participant lamented (Interview, Participant 21). Another echoed this sentiment, "*The roads and bridges get destroyed every time, and no one helps us to rebuild them properly*" (FGD, Community Leader 7). This shows that the literature's focus on infrastructure must also consider governance challenges. The study bridges this gap by recommending stronger partnerships

between local communities, government agencies, and NGOs to create long-term, sustainable solutions for flood management.

5.5 Contribution to the Field and Bridging the Research Gap

This study makes a significant contribution to the literature by integrating community perspectives, local practices, and socio-economic factors into the broader discourse on flood adaptation in semi-arid regions. The research explicitly addresses the gap concerning the socio-cultural and economic barriers that prevent effective community engagement and adaptation to flood risks. As one community leader said, "*We need help, not just with money but with understanding how we can work together to fix these problems*" (FGD, Community Leader 2). By providing a comprehensive framework that involves community-led interventions, capacity-building programs, and stronger governance, the study offers a holistic approach to flood adaptation that can be applied to similar communities in semi-arid regions.

6. Conclusion

This study examined and evaluated the level of community engagement and awareness regarding flood hazards in Ringim LGA of Jigawa State, Nigeria. By grounding the analysis in Social Learning Theory and Participatory Risk Governance, this study demonstrates that effective flood risk management in semi-arid Ringim depends on strengthening participatory processes through which awareness is generated and sustained. The findings extend these to a Nigerian semi-arid context, showing that engagement mediated by traditional leadership and socio-cultural norms plays a decisive role in shaping risk perception and adaptation outcomes. This theoretical integration reinforces the need for policies and interventions that prioritise inclusive participation, continuous learning, and stronger institutional–community linkages to enhance flood resilience in similar contexts.

The triangulated analysis of interviews, an FGD with community leaders, and participatory observation confirmed that although flood hazards are recognised by the community, participation in organised preparedness and adaptation measures remains limited. Informal coping actions exist but are fragmented, under-resourced, and lack formal institutional backing. The research found that socio-cultural factors (such as traditional hierarchies, gender roles, and local belief systems) play a significant role in shaping both awareness and participation levels. Awareness campaigns are sporadic and not sufficiently tailored to local contexts, while gaps in infrastructure and governance further exacerbate vulnerability. The findings conclude that current levels of participation and awareness are inadequate for effective flood resilience, highlighting the urgent need for culturally sensitive engagement strategies, sustained awareness programmes, and stronger community–institutional partnerships to mitigate future flood risks in semi-arid environments like Ringim.

This study advances the discourse on flood risk management by moving beyond conventional top-down approaches, which often neglect the nuanced interplay of local knowledge, socio-cultural dynamics, and community-led adaptive strategies. While recognising the value of informal coping mechanisms, the research reveals their insufficiency in addressing increasingly severe floods, especially when compounded by economic constraints, inadequate infrastructure, and cultural resistance to relocation or modern prevention measures. By integrating community perspectives into formal decision-making, the study fills a critical gap in existing literature and offers actionable guidance for policymakers and stakeholders, demonstrating that sustainable flood adaptation in semi-arid regions like Ringim requires strategies that are technically sound, economically feasible, and culturally sensitive. The findings provide a basis for developing more inclusive, participatory, and context-specific policies that strengthen community ownership, enhance awareness through tailored education programs, and build technical and financial capacity. For stakeholders such as government agencies, NGOs, and local leaders, the study underscores the importance of fostering collaboration, improving governance structures, and embedding community engagement within formal flood risk management frameworks.

While this study provides valuable insights into the socio-cultural dimensions of community engagement and flood risk awareness in semi-arid Ringim, several limitations should be acknowledged. Methodologically, the reliance on qualitative data from interviews and focus group discussions limits the generalizability of the findings, as the results reflect the perspectives of a specific set of informants within a defined geographical context. Theoretically, the lack of an explicit guiding framework may have limited the depth of interpretation, particularly in establishing causal links between community engagement and awareness. Contextually, socio-political dynamics, seasonal variations, and cultural sensitivities may have influenced informants' responses, potentially introducing bias. Recognising these limitations highlights the need for future studies to adopt mixed-method or comparative approaches, integrate longitudinal designs, and apply robust theoretical models to deepen understanding and strengthen the applicability of findings.

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Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper

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