Exploring the Impacts of Community Involvement in Flood Management Strategies: A Case Study of Bor South County

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Abstract

This case study explores the critical role of community involvement in flood management strategies in Bor South County, drawn from a total of six (06) Focus Group Discussions and fifty (50) Key Informants through qualitative methods, who were interviewed to understand community participation in influencing flood resilience. Key findings revealed that community involvement enhances early warning systems through traditional knowledge, facilitates rapid local response, and promotes adaptive measures such as the elevation of homes and the creation of community dykes using local materials. The presence of community-based disaster risk management and youth (self-help groups) strengthens community resilience by enabling collective action and resource mobilization. However, challenges persist, including limited financial resources, weak coordination between stakeholders, marginalization of women and youth, and dependency on humanitarian aid. The study concludes that while community-led efforts are not a solution, they form a crucial component of effective flood management. Therefore, strengthening local institutions, integrating traditional knowledge with scientific approaches, and promoting inclusive participation can significantly enhance disaster resilience in flood-prone areas. This research will contribute to policy-relevant insights for enhancing flood preparedness and climate resilience in Bor South County, Jonglei State, South Sudan, and similar contexts globally.

Keywords: Community involvement, Climate resilience, Flood Management, Flood Strategies, Community perception.

Introduction

Flood management in South Sudan, particularly in Bor South County, has been primarily driven by humanitarian actors, including international NGOs and UN agencies, although government authorities have also made inadequate interventions. Over the past decade, the County has experienced escalating flood events, displacing hundreds of thousands, destroying farmlands, infrastructures, and deepening food insecurity. These floods are driven by climate variability,

overflowing rivers, poor land-use practices, and underinvestment in resilient infrastructure (FAO, 2023; UNOCHA, 2022). Since 2019, seasonal floods have become more prolonged and intense, and eventually result in floodwaters persisting for months, disrupting agricultural production, limiting access to basic services, and restricting movement across the County, affecting thousands of people. According to UN OCHA (2023), nearly two-thirds of the country's counties have been impacted by floods at varying magnitudes. The recurrence of these events is eroding traditional livelihoods and weakening national recovery efforts. Jonglei State is one of the most flood-prone and conflict-affected States in South Sudan. It's flat terrain, expansive wetlands, and proximity to the River Nile and its tributaries expose communities to seasonal and flash flooding. Between 2020 and 2024, Jonglei experienced the country's most severe flooding events, displacing thousands annually, especially in counties like Bor South, Twic East, Duk, and Ayod.

Amidst this challenging environment, communities in Bor South County, particularly in Payams like Baidit, Jalle, Kolnyang, and Makuach, possess a rich traditional knowledge and adaptive strategies that were developed traditionally over generations of living in flood-prone areas. As noted by UNDP (2022), community members in the County possess valuable traditional knowledge and experience in coping with floods, ranging from early warning signs, local engineering practices, and communal resource pooling, which remain underutilized in formal disaster management frameworks. Yet, the lack of systematized documentation, institutional integration, and scaling of these indigenous practices continues to limit their potential contribution to broader disaster preparedness strategies. Humanitarians and government interventions often overlook these locally rooted solutions, relying instead on top-down approaches, which are externally driven models that may not align with community realities. Bridging this gap between community-based knowledge systems and formal disaster risk management is essential for building resilience in flood-prone regions like Bor County. Flood-coping strategies, such as seasonal movement, elevated homesteads, community-led evacuation n plans, and use of local resources like pools to build temporary dykes, have played a vital role in managing flood risks; however, these strategies are gradually stressed by rapid climate changes, population pressure, and declining access to resources. As such, there remains a critical gap in understanding how to systematically integrate these community-driven approaches with formal disaster management frameworks, particularly within the context of South Sudan's fragile governance and humanitarian challenges (SSNBS & RRC, 2023). Empowering community leaders, institutionalizing community participation, and integrating traditional and scientific approaches can enhance the effectiveness, sustainability, and ownership of flood risk reduction strategies. This contextual foundation underscores the need for further research, policy attention, and programmatic investment to harness local capabilities as a core pillar of climate resilience in Bor South County and South Sudan at large.

The findings of this study are expected to contribute to the growing body of literature on community-based disaster risk reduction (CBDRR) and to advocate for a more inclusive, participatory, and context-sensitive approach to flood management. Ultimately, this research underscores the urgent need to place communities at the heart of flood resilient efforts, and not only as beneficiaries but as active agents of disaster change, and as a mechanism of advocacy by International Organizationon of Migration (IOM) and other partners in the field of disaster risk management, like VNG International and South Sudan Red Cross.

Historical background of flooding in Bor South County

In 1964, floods occurrence sporadically disrupted life, livelihoods, and displaced thousands, with the most severe events happening in 2019, 2020, and 2021, which left a stressful experience among the residents of Bor South County. The County's flood is shaped by its proximity to the White Nile and its flat topography, resulting in seasonal flooding, primarily caused by excessive rainfall and overflow from the White Nile River. These floods have intensified in recent years due to climate change, deforestation, and inadequate flood management infrastructure. The geographical landscape of Bor South County is characterized by vast floodplains, swamps, and low-lying areas, making it particularly vulnerable to extreme weather events. The population living in the County is predominantly composed of agro-pastoral communities who rely on cattle herding and subsistence farming for their livelihoods. The annual flooding cycle disrupts agricultural activities, destroys grazing lands, and exacerbates food insecurity in the County. The vulnerable groups, including women, children, the elderly, and internally displaced persons (IDPs), are disproportionately affected by floods, as they have limited access to resources and coping mechanisms. Many residents are forced to migrate seasonally to higher ground, leading to further displacement and socio-economic instability. The recurrent nature of these disasters has highlighted the need for sustainable flood management strategies that incorporate both modern and traditionall approaches. The picture in *Figure 1* illustrates the magnitude of the damage during the 2020 floods in Bor town, Makuach Payam.

Figure 1: Some houses were submerged in water during the 2020 floods.

Source: Floods in Bor Town, Makuach Payam, Jonglei, South Sudan, August 2020. Photo: UNHCR / Komma Godfrey - https://floodlist.com/africa/south-sudan-floods-august-2020

The previous government and humanitarian responses, such as dyke construction, non-food items distribution, and emergency food distribution, provide a short-term solution that can not address the underlying vulnerabilities of affected communities, thus making the disaster a persistent phenomenon. However, the political context of flood management in Bor South County is influenced by South Sudan's broader governance challenges, including political tensions, prolonged inter-communal conflicts, limited capacity, and economic instability. The country's fragile peace process and governance structures impact the ability to implement long-term disaster risk reduction measures. Addressing these challenges requires a multi-stakeholder approach that involves collaboration between government and local communities to develop sustainable and inclusive flood management policies. Nevertheless, the County's geographical

vulnerability, socio-economic conditions, governance challenges, and historical flood events underscore the urgency of adopting a comprehensive flood management strategy. The integration of community-led approaches with government and NGO interventions will be critical in reducing the impact of floods and enhancing local resilience.

Literature Review

Flood management strategies differ across regions, incorporating both structural and non-structural measures to reduce flood risks, which necessitate collaboration from different stakeholders: government, humanitarian agencies, and communities. According to scholars, structural measures, such as levees, embankments, and drainage systems, are commonly used to control floodwaters, while non-structural approaches include early warning systems, land-use planning, and community-based preparedness programs (Aerts et al, 2018) are helpful for flood mitigation. However, researchers argue that the top-down approaches of flood control measures are insufficient and that integrating community-based approaches can enhance resilience and sustainability (Gaillard & Mercer, 2013). The community participation in flood management has been recognized as a key factor in disaster risk reduction (UNDRR, 2015), and as such studies have shown that local communities play a critical role in flood preparedness, response, and recovery, leveraging indigenous knowledge to develop adaptive strategies (Hiwasaki et al., 2014); such strategies are seen very effective in some regions, for instance, in flood-prone regions of Bangladesh, community-led flood warning systems and elevated housing structures have proven effective in reducing disaster impacts (Rahman et al., 2016). Similarly, in African floodplains, traditional knowledge, such as seasonal migration and flood-resistant crop cultivation, has been instrumental in mitigating flood risks (Nyong et al., 2007).

Despite the benefits of community involvement, several challenges hinder effective participation in flood management plans. These challenges include inadequate government support, lack of financial resources, limited access to information, and weak institutional frameworks (Few et al., 2007). In the context of South Sudan, the protracted conflict and fragile governance structures further complicate flood risk management efforts (World Bank, 2021). Additionally, the displacement of communities due to persistent flooding disrupts local adaptation mechanisms, and as such, it keeps increasing vulnerability to climate-induced disasters (Relief Web, 2021).

To realize the importance and needs of flood management and the involvement of communities in flood management, indigenous knowledge plays a vital role in flood risk management, offering context-specific and culturally relevant adaptation strategies. Studies highlight the importance of integrating indigenous and scientific knowledge to create holistic flood management frameworks (Kelmet et al., 2012). In Sub-Saharan Africa, local communities have traditionally relied on flood-resistant housing techniques, early warning signs based on natural indicators, and communal resource-sharing to cope with floods. However, the marginalization of indigenous knowledge in formal disaster management policies limits the potential contribution to sustainable flood mitigation efforts (Mercer et al., 2012).

Besides, the role of policy frameworks and institutional coordination in flood management cannot be overlooked. Effective flood risk governance requires multi-stakeholder collaboration involving government, humanitarian organizations, research institutions, and local communities (UNDP, 2020). In many developing countries, decentralized disaster management approaches have facilitated greater community participation in flood mitigation initiatives (Satterthwaite,

2011). However, in South Sudan, gaps in policy implementation and coordination among agenci es remain a significant challenge (World Bank, 2021).

The existing literature underscores the importance of integrating community participation, indigenous knowledge, and institutional collaboration in flood risk management. While structural interventions remain essential, community-led approaches enhance the sustainability and effectiveness of flood mitigation efforts.

Methodology

This study employed a qualitative research design to enable an in-depth exploration of complex social dynamics surrounding community participation in flood management within Bor South County, a context marked by recurrent flooding and socio-political challenges. The approach was particularly suitable for capturing local knowledge systems, perceptions, and participatory practices. Data collection was guided by semi-structured tools, including interview guides for Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs), which allowed for flexibility while maintaining thematic consistency. To enhance the validity and depth of findings, data triangulation was employed. In addition to KIIs and FGDs, the study incorporated direct field observations and document reviews to contextualize and corroborate primary data.

Participants and Data Collection

Participants were purposefully selected to represent a wide range of local stakeholders with diverse knowledge and experiences in flood management. Data collection involved four main techniques: KIIs, FGDs, non-participant observation, and document review.

A total of 50 Key informant participants were interviewed, with representatives from local government (including Payam Civil Administrators, Payam Relief and Rehabilitation Commissions, County Executive Director, and other officials), traditional leadership (chiefs), humanitarian organizations (such as IOM, FAO, South Sudan Red Cross, and VNG International), as well as local actors including youth leaders, women leaders, teachers, and religious figures. In addition, six Focus Group Discussions were held with youth groups, women groups, and the community elderly to capture intergenerational and gendered perspectives on flood-related challenges and responses. Document reviews focused on existing literature, including government reports, NGO assessments, and academic publications relevant to flood management in Bor County, were also considered.

Analytic Approach and Justification

The thematic analysis approach was selected for its flexibility in processing qualitative data and its ability to uncover both explicit and implicit meanings within participant narratives. this analytic approach captures localized understanding and responses to flood risk, ensuring the study remained grounded in local realities while aligning with broader theoretical frameworks on participatory disaster risk reduction. The integration of multiple data sources (interviews, discussions, observation, and secondary documents) strengthened the study’s methodological rigor and ensured triangulation. This comprehensive analytic strategy supports s holistic interpretation of the community flood management capacities and challenges within a complex socio-environmental landscape.

Rationale for Methodological Design

The chosen approach is threefold in the context-specific exploration where the researcher will capture this contextual complexity and real-life setting, which would be difficult to quantify using purely statistical methods (Creswell & Poth, 2018). The case study method is well-suited to answering "how" and "why" questions, such as how communities engage in flood response, or why traditional knowledge remains underutilized in formal disaster frameworks (Yin, 2018). These types of questions are central to the research objectives of this study.

Data Analysis

All qualitative data obtained from KIIs and FGDs were transcribed verbatim and analysed thematically. A manual open coding process was used initially to identify emerging categories and patterns. These codes were then refined and grouped into broader themes that align with the research objectives. Themes were developed around core areas such as community participation, use of indigenous knowledge, institutional coordination, and outcomes of local flood management strategies. Attention was paid to both converging and diverging narratives across different stakeholder groups to ensure a nuanced understanding. The document review data were analysed through content analysis, focusing on policy gaps, intervention coverage, and alignment with community-level experiences. Observation notes were used to validate or contrast interview findings and to contextualise key thematic areas.

Results

Bor County has been affected by two major types of floods: seasonal riverine flooding and pluvial flooding. The riverine flooding primarily happens as a result of the river Nile overflowing and its attributes, especially during the peak of rainy seasons, which typically impacts areas along the river banks and low-lying areas. On the other hand, pluvial flooding results from intense, prolonged rainfall that exceeds the capacity of natural and man-made drainage systems, leading to widespread inundation of residential and agricultural lands. In such a situation, the farmlands and homes will be affected widely when it continues raining for more days.

Community Perception on Floods.

Participants in the Focus Group Discussions highlighted that the triggers of floods in Bor County are increasingly linked to the effects of climate change, and as such, it results in the river overflow. The key informants from various payams such as Baidit, Makuach, Anyidi, and Kolnyang, emphasized that most areas, being geographically low-lying settlements, are espe cially vulnerable to river overflow. Over the past few years, the intensity and frequency of rainfall events combined with river overflow have dramatically increased, overwhelming both natural and constructed environments and livelihood activities. Several informants noted that changes in weather patterns, such as unpredictable rain cycles, have contributed to sudden and severe flooding decades ago.

> *"The rains come when people are least expected and with no preparation made available, when it rained, within an hour or more hours, the entire settlements were submerged in water"— A Youth Leader from Anyidi Payam*

Such climatic changes have immediate consequences on homes, public infrastructure, and farmlands, as well as disruption of livelihoods and sudden displacement of communities.

Reflecting on thee flood of 2020-2021, nearly all participants from the focus group discussion stated that most homes were submerged in water and thousands of people were displaced. That was an unforgettable moment and marked one of the most catastrophic flooding events in the county's recent history.

> *"It was the worst flood I have ever witnessed in my lifetime. I saw elderly peo ple, children, pregnant women, and people with disabilities struggling to wade through rising waters, trying to find higher ground. Many others were carried with the help of a plastic sheet, some used makeshift rafts; it was truly heartbreaking,"— Civil Administrator, Makuach Payam.*

The scale of displacement during this period was described as "unprecedented", with most villages submerged, and thousands of families fleeing to the overcrowded internally displaced persons (IDP) camps like the Mingkaman IDP camp. The floodwaters destroyed schools, health facilities, markets, roads, and bridges, cutting off essential services and hindering emergency response efforts. Agricultural productivity was also severely disrupted, as many farmlands were completely waterlogged, leading to widespread food insecurity and loss of livelihoods. In the sub sequent flood situation, livestock were disrupted, leading to the migration of cattle and resulting in limited access to products, as most cattle migrated far away from their owners. In addition to natural causes, the discussions revealed that several human-induced factors continue to worsen the severity of floods in Bor County. A teacher from Langbaar Primary School (Makuach Pay am) explained that a lack of awareness and limited education about disaster risks play a significant role.

> *"People don't understand the risks they face when they settle in flood-prone areas; many are unaware of these dangers, and they find it comfortable to settle near waterways, as this is associated with the population growth in town," – Langbaar Teacher stated.*

Many households unknowingly construct their homes in waterways that are historically prone to flooding; this increases their vulnerability. Additionally, participants from the FGD pointed out that the lack of effective early warning systems and inadequate flood preparedness planning are major setbacks. The local government and relevant agencies are perceived as being reactive rather than proactive. For example, alerts and evacuation messages often arrive late or are not effectively disseminated, and in most cases, warning messages are written in a language that most residents cannot read. For instance, most messages are written in English but not in the local language, leaving communities unprepared when floods occur. The absence of long-term flood management strategies and the enforcement of land use regulations were also recurring issues. Participants noted that despite frequent floods, little has been done to relocate vulnerable populations, build embankments or dykes, or implement sustainable land management practices.

> *"We talk about floods every year, but we never prepare for the risks associated with floods. People are caught unaware by flood incidents, and as such, people are severely affected," – BCYA Youth leader reported.*

Both the Focus Group Discussions and key informants' respondents highlighted a vivid picture of a community under threat from both nature and neglect. The combination of climatic factors, insufficient infrastructure, low public awareness, and weak institutional capacity has left Bor County highly susceptible to recurring and increasingly devastating floods. With such a situation, there is little intervention done by the community, government, and agencies. However, there is

an urgent need to solve increasing flood events by integrating a flood risk management strategy that incorporates community education, resilient infrastructure development, improved drainage systems, and a timely early warning system to reduce vulnerability and build community resilience.

Forms of Community Involvement in Flood Management.

The community involvement in disaster risk management, particularly flood management, is widely recognized as a cornerstone of building resilience and effective disaster response (IFRC, 2021; UNDRR, 2019). In Bor County, the empirical evidence gathered through key focus group discussions and key informant interviews underscores the significant role of communities in mitigating and managing the recurrent impacts of flooding. Participants repeatedly emphasized that despite the limited external support, communities have historically relied on well-organized structures and indigenous knowledge systems to cope with the seasonal inundations that threaten the lives and livelihoods of the population.

The respondents cited many locally driven strategies through which community members actively engaged to contribute to flood management. These include the use of traditional early warning systems based on environmental indicators such as the migration behaviors of animals and birds, the rise of water levels in the river, soil saturations, and wind patterns. However, for the preparedness in response to the warning system, communities construct makeshift dykes and elevated homes, form the grassroots disaster risk management committees, and seek further support from networks among families.

> *"We do not wait for outside help; when water begins to rise, we gather, dig trenches, and move our families and cattle to higher ground," – head chief, Makuach.*

These informal efforts, though sometimes lacking alignment with formal disaster management frameworks, are crucial for immediate response and long-term adaptation. As noted by another youth leader during the field visit, "*even if the government or NGOs delay, we already know what to do as a community, we have done this for generations*." This finding aligns with the literature, which highlights that community-based approaches, particularly in rural and resource-constrained settings, often serve as the first line of defense in disaster contexts (Twigg, 2015; Gaillard & Mercer, 2013). Moreover, such engagement fosters a sense of ownership, collective responsibility, and local empowerment, a key principle emphasized in the Sendai Framework for Disaster Risk Reduction (UNDRR, 2015). Despite the challenges posed by weak infrastructure and limited institutional coordination, the adaptive strategies and solidarity among residents of Bor County illustrate the potential of grassroots action in enhancing flood resilience.

Traditional Early Warning System (TEWS)

In Bor County, traditional early warning systems remain a vital mechanism for predicting and preparing for floods at the grassroots level. These systems, grounded in indigenous knowledge and environmental observation, have been used for generations to anticipate weather-related threats. During the focus group discussions (FGDs) and key informant interviews (KIIs), it was revealed that community involvement in flood management in Bor County primarily occurs through various informal and locally driven mechanisms. These include traditional early warning systems, community-led infrastructure, social support networks, and grassroots disaster response activities such as forming a disaster risk management committee. Although some of these

mechanisms may not always match formal disaster risk management frameworks, they are essential in strengthening local resilience and preparedness.

To prepare for flood defenses, communities utilize mechanisms to detect impending floods, which are highly effective in grassroots flood management. During the discussion, the partici pants revealed how the Traditional Early Warning Systems (TEWS) help them to understand climate change. Amidst the discussion, the head chief of Baidit Payam cited that the community members use indigenous knowledge to anticipate floods.

> *"During our ancestors times, to know the whether there will be floods that yea r or not, changes in bird migration (birds like white-faced whistling duck – locally known as "aluluei", and "Agaal"), noticeable heat wave, presents of locust and grasshopper, rampant present of black-ants in February, when water hyacinth increases and water level keep increasing, soil saturation level s, rising of water in the river being detected by fishermen, and when antelope (locally known as "Juil") migration in huge number, all these are observed and when such indicators are happening, there are prediction that floods will occur," – head chief, Baidit.*

These traditional early warnings keep helping the communities to be alert and get prepared before flooding occurs. Such early warning mechanisms enable early preparation actions like moving livestock, reinforcing homes, or gathering food supplies (UNDP, 2022). Traditiona lly, the Chiefs are always responsible for any decision to alert the communities about the impending flooding. They played a critical role in disseminating these warnings through communal gatherings or verbal instructions passed from house to house.

> *"We don't wait for radios, our means of communicating the message to our co mmunities is through house-to-house visits, announcements through a louder person, or megaphones; the signs are around us every day. Traditional warning is the best because it is fast, personal, and trusted." Kolnyang Chief stated.*

In contrast, modern early warning systems (MEWS) introduced by NGOs or government actors r ely on meteorological data, satellite monitoring, and digital communication tools such as radio alerts or SMS. However, most respondents stated that lack of access to these modern systems hinders passing of warning messages to the common people, perhaps this could be due to poor mobile network coverage, illiteracy rate, and limited trust, hence the community relies most on the traditional early warning systems that exist and are quick to analyze.

> *"Sometimes we hear the announcement through either radio, megaphones, or t hrough community announcement saying a flood is coming, but by that time, water is already in our compounds," - A woman in Makuach noted,*

The community's preference for TEWS is rooted in its cultural relevance, accessibility, and proven track record. While modern systems offer scientific precision, they often fail to reach the most vulnerable populations in time due to the high bureaucracy in place. Scholars argue that TEWS are essential in building locally adaptive flood preparedness strategies, especially in remote and low-resource settings like Baidit, Makuach, Anyidi, and Kolnyang (Mercer et al., 2010; IFRC, 2020). Integrating TEWS with MEWS could therefore offer a more inclusive and effective early warning framework.

Flood Management Techniques by the community in Bor County

Flood management by local communities in Bor County involves a set of practical, experience-based techniques developed through decades of living in flood-prone environments. These techniques are typically low-cost, resourceful, and tailored to local geographical conditions. The community-led construction of flood defenses has been a significant initiative during recent years of flooding in Bor County. Baidit Payam's respondent notes that each year, communities are mobilized to build or repair broken dykes that protect lives, homes, livelihoods, infrastructure, and cattle. Focus Group Discussion participants stated that every year, when floods happen, residents actively participatete in constructing and maintaining dikes and embankments using traditional tools and locally available materials such as mud, logs, and gr asses. These community-built defenses serve as the first line of protection against river overflows, especially in areas like Baidit, Makuach, and Anyidi, where residents take part in constructing and repairing dykes. One of the dykes constructed by the community in Baidit is shown in *Figure 2* below. To facilitate coordination and ensure quality work, chiefs and local elders often organize labor through communal work groups known as "*wut or dhin*," particularly during the peak flood season.

> *"Decades ago, our ancestors used a local strategy of compacting sand around their home's compound to help create a highland free from floods. Such a strategy has long been abandoned," – a secondary school teacher, Baidit.*

Figure 2: Homestead elevator was made to create a highland and a temporary dyke.

Source: author, field visit in Baidit, photo 17th May 2025. Source: author, A dyke constructed by community members in Baidit, Angakuei.

However, due to sporadic increases in floods, such responsibility (local decision-making) has slightly changed from the chief to the DRM committees that are formed with the support of the chiefs and Payam administrators. The Community-Based Disaster Risk Management (CBDRM) committee is formed to support the Payams and the County on disaster risk communication and management, monitoring of disasters, and reporting.

"There are existing committees at the Municipal Council, but at Payam and Boma level, such committees are not functioning enough due to vulnerability of the government, lack of enough resources, and mobility challenges, thus lessening their task", – Executive Director, Bor County.

Recent supportive initiatives, such as the Sustainable Development Through Improved Local Governance (SDLG) project, funded by the Kingdom of the Netherlands and implemented by VNG International in Bor, have aided the formation of Payam Development Committees (PDCs) and the DRM committee at the Boma level.

"These structures are intended to improve community resilience and will strengthen flood preparedness, as the project will help communities to become more resilient and will be able to fight disasters in the community. We are implementing the bottom-top approach to strengthen the project ownership, decision-making at the grassroots level, and to strengthen the coordination and communication with Payam, County, and State level," – Program Manager, VNG stated.

Although the DRM committee helps in disaster risk communication and management, participants stress that resource pooling and mutual support hinder the living standard and contribute to poor management of disasters like floods. In the face of limited external support, communities often rely on internal social safety nets. In this regard, extended families and clan networks share food, water, boats, and shelter, particularly with widows, the elderly, persons with disabilities, and displaced households. This social cohesion plays a crucial role in reducing vulnerability, though it is not sustainable and it's very limited. In addition, women's and youth participation is often underrepresented in formal settings, though they play critical roles in flood response.

"We women keep managing the household preparedness, relocating children and food supplies, and caring for vulnerable family members when floods happen," – a woman leader stated.

"When dykes break, 3 bullets are fired in the air to alert youth such that they c ome to the broken point and repair. I spent 3 days always walking in water to monitor the dykes and report when they're broken, spending nights and days without eating – this is because I want to save my people during flooding," – Makuach Youth Leader.

Youth in the communities construct the dykes, as shown below in *Figure 3*.

Figure 3: A dyke constructed in Makuach Payam, Bor County

Source: An inundated dyke in Bor in 2020-2021. (Credit: UN

Modern Flood Management vs Traditional Flood Management

A central theme that emerged from the study is the co-existence and often the clash between modern and traditional flood management approaches. While both aim to reduce vulnerability and protect the lives of the people, their methods and tools often differ.

The modern flood management in Bor County is typically introduced by NGOs, such approaches include infrastructural interventions such as mechanized dyke construction (using a machine) as shown in Figure 4 below, differ from manual construction of dykes using hand with available local materials, like pools, sandbags, grass, muds etc, installation of water pumps, which represent hand-use flashing out of water by locals, distribution of flood relief kits, and formal evacuation plans. These interventions are designed using scientific data and executed through top-down planning models. However, community members reported several limitations, as stated by a respondent from Anyidi.

"We see machines building dikes, but when the machines leave, no more maintenance of dykes, but we do maintenance manually without using machines." – Youth leader, Anyidi.

Figure 4: Machine working on dykes.

Source: IOM Outreach Shelter Assistant inspects the construction work. ©IOM2021/Nabie Loyce - https://southsudan.iom.int/stories/construction-dike-brings-hope-flood-affected-communities-bor-0

In contrast, traditional flood management emphasizes community mobilization, indigenous knowledge, and sustainable use of local resources. Techniques like elevated homes, communal labor systems (wut), and traditional early warning practices are deeply rooted in local culture. Unlike modern interventions, these practices often require minimal external support and promote self-reliance.

> *"We have survived for generations without NGOs. Our knowledge comes from our fathers and grandfathers, and it works," - A chief in Makuach stated.*

While modern approaches offer technical superiority and can respond to large-scale crises, they often lack sustainability due to limited local ownership. Many such projects collapse when external funding ends and when local skills are not developed or integrated. Conversely, traditional systems, although resource-constrained, offer durability and adaptability in resource-poor settings. Experts advocate for a hybrid model that leverages the strengths of both systems. Mercer et al. (2010) recommended integrating scientific flood prediction tools with local observ ation methods, while IFRC (2020) emphasizes training community members to bridge the knowledge gap. This integrative approach could enhance resilience and ensure community-dr iven, context-sensitive flood management in fragile areas like Bor County.

Discussion

Community involvement plays a pivotal role in disaster risk reduction; the community's unique measures of managing floods and reducing their escalations are most affordable and effective. While floods remain a persistent threat exacerbated by climate change and weak infrastructure, the resilience and adaptability of local populations offer a powerful asset in disaster risk

reduction. The residents of Bor County possess valuable knowledge, organizational skills, and social solidarity mechanisms that, if adequately supported, can transform flood responses from reactive to proactive. However, the study also reveals that current flood management strategies often overlook or underutilize this community capacity due to governance challenges, exclusive planning processes, and socio-political instability. To ensure long-term resilience, a shift is needed from externally dominated interventions to locally owned, inclusive, and knowledge-integrated approaches. By bridging traditional and modern systems, and ensuring community voices are central in planning and execution, Bor South can move toward a more adaptive and sustainable model of flood management.

The findings of this study affirm that community involvement is central to effective flood management in Bor County. Local communities have consistently developed and applied their own coping strategies, such as early warning through indigenous indicators, communal dyke construction, and temporary relocation to higher grounds. These measures, while often low-cost and context-specific, demonstrate that community-driven practices are both affordable and practical compared to externally imposed interventions (Mercer et al., 2010; Twigg, 2015). However, the study also highlights critical challenges undermining the effectiveness of community-led initiatives. Despite their resilience, communities often lack sufficient technical support, financial resources, and infrastructural reinforcements to sustain their efforts (IFRC, 2021). Governance challenges, weak institutional coordination, exclusive planning processes, and limited integration of indigenous knowledge into formal flood policies further weaken the effectiveness of local strategies (UNDRR, 2019).

Additionally, socio-political instability and recurring conflicts in the region disrupt collective action and divert resources away from disaster preparedness (ReliefWeb, 2021; Jok, 2020). The evidence suggests that bridging local knowledge with scientific and modern systems would not only strengthen early warning systems but also enhance the relevance and ownership of interventions. For instance, local indicators of flood prediction could be complemented with hydrological modeling to provide more reliable forecasts (Nyong et al., 2007). Similarly, while the community demonstrates strong organizational skills and solidarity mechanisms, these efforts remain underutilized due to a lack of recognition within formal planning frameworks (Allen et al., 2017).

Based on the findings, several recommendations emerge. First, there is a need for inclusive planning and decision-making processes that place community voices at the center of flood management policies (Chambers, 1994). Second, strengthening the institutional capacity of the Relief and Rehabilitation Commission (RRC) and local disaster management committees can create a platform for collaboration between government, humanitarian actors, and community structures (Government of South Sudan & UNDP, 2020). Third, investment in resilient infra structure such as elevated roads, flood-resistant housing, and properly managed drainage systems would reduce the recurrent disruptions caused by flooding (World Bank, 2021). Finally, continuous capacity building and awareness programs can ensure that community-based knowledge evolves alongside modern risk reduction approaches (UNDRR, 2015). Looking toward the future, the study underscores the importance of adopting locally owned, knowledge-integrated, and adaptive flood management models. This entails not only addressing governance gaps but also building trust and collaboration across stakeholders. Integrating indigenous knowledge with scientific tools, while simultaneously empowering communities with resources

and decision-making authority, will foster a sustainable and proactive flood management system in Bor South County (Mercer et al., 2012; Nyong et al., 2007).

Theoretical and Policy Implications

The findings of this study reveal that community involvement is not only a fundamental aspect of effective flood management in Bor County but also a critical determinant of resilience, sustainability, and local ownership. Despite being a fragile County and conflict-affected setting, the communities in Bor County demonstrate strong indigenous coping mechanisms, collective action, and local leadership, which contribute to a meaningful flood risk reduction effort, though inadequate resources hinder most of the activities.

This study supports the broader literature emphasizing that flood risk management cannot succeed without the meaningful participation of affected populations (Twigg, 2015; Gaillard & Mercer, 2013). Community-led initiatives in Bor County, such as early warning dissemination, construction of traditional dykes, and use of indigenous knowledge, align with the principles of Community-Based Disaster Risk Reduction (CBDRR). These practices contribute to faster response times, efficient resource use, and improved social cohesion, all of which are hallmarks of resilient communities (UNDRR, 2022). A recurring theme across key informant interviews and focus group discussions was the marginalization of local voices in formal disaster planning. This reinforces critiques of externally driven humanitarian responses that prioritize speed and scale over inclusiveness and sustainability (Béné et al., 2014). Without community buy-in and contextual understanding, interventions such as large-scale dyke construction or forced relocation often face resistance or underutilization. However, the incorporation of indigenous knowledge, such as seasonal forecasting based on environmental indicators or using natural elevations for shelter, has proven to be an adaptive, cost-effective measure that complements scientific flood management approaches. These findings are consistent with studies that argue for hybrid models combining local and scientific knowledge (Mercer et al., 2010). Additionally, strong social capital among clans and age groups provided a crucial safety net in times of crisis, particularly in resource sharing and communal rebuilding.

The study also highlights major gaps in inclusivity, especially regarding the role of women and youth. Despite their active contribution during crises, they remain underrepresented in formal leadership structures and decision-making bodies. Furthermore, governance weaknesses and political instability in Jonglei continue to undermine coordinated flood response, hinder access to remote areas, and increase the vulnerability of displaced populations. These challenges reflect the broader need to strengthen disaster governance systems at both the local and state levels.

Practical Recommendations

Based on the key findings and community insights from Bor County, the following actionable recommendations are proposed to enhance flood management and resilience through inclusive, locally grounded, and sustainable approaches.

1. First, there is a need to institutionalize community participation in flood governance. To ensure sustainable and effective flood risk management, community participation must be systematically embedded in governance structures at all levels.
    i) To make this an actionable step, there is a need to establish formalized disaster governance platforms at the Boma, Payam, and County levels,

such as community Disaster Management Committees (CDMCs), where community members, especially women and youth, are elected to represent local voices in planning and decision-making.

ii) Another second step that should work is localized mobilization of logistical and financial support to these committees to carry out risk assessments, participate in early warning dissemination, and monitor infrastructure conditions, e.g. dykes and drainage systems.

iii) Another actionable step should be to integrate participatory planning into local government frameworks, ensuring that flood response plans are co-developed with community members. UNISDR cited that community participation is the foundation for sustainable disaster risk management. Institutionalizing such mechanisms leads to improved ownership, responsiveness, and accountability (UNISDR, 2015).

2. Second, there is a need to integrate indigenous knowledge with scientific approaches. During the interviews, the indigenous people who received the warning knowledge found it very helpful and supported the communities to alert their members about the crisis. Indigenous early warning indicators and traditional flood coping strategies should not be sidelined but rather integrated with modern scientific data to develop a more holistic approach.

   i) To make this actionable step, first develop the hybrid knowledge systems by combining local signs of flood (e.g., animal migrations, bird migrations, soil saturation, presence of black ants, etc.) with satellite-based flood forecasting and meteorological alerts. This will enhance a quick intervention in terms of alerts and response.

   ii) Second steps, training of community disaster management committees, humanitarian and government staff in participatory risk assessment tools that include local knowledge mapping to document and validate community-based observation and practices. Scholars such as Mercer et al (2010) express how important it is to train humanitarian and government officials in Participatory Risk Assessment tools.

   iii) Third step, there must be facilitation of community scientist exchanges through workshops and focus groups, by creating mutual learning spaces for the sharing of resilience building. Disaster risk reduction is most effective when it draws on both local knowledge and scientific research to co-create solutions (IFRC, 2020).

3. Third, strengthen the DRM Capacity Building at the community Level. Enhancing local capacities will reduce dependency on external actors and ensure faster, more contextually appropriate responses during emergencies.

   i) First action step: training of local leaders, youth, and women volunteers on flood early warning protocols, basic engineering (dyke construction, drainage), emergency first aid, and climate adaptation techniques.

ii) Second step, introduce Community Emergency Response Teams (CERTs) at the Payams level, equipped with simple tools, radios, and protective gear.

iii) Thirdly, provide simulation-based training (flood drills) annually to test preparedness, reinforce roles, and build community confidence in responding to disasters. Building local capacities is not only empowering but crucial for timely and effective responses to natural hazards (ALNAP, 2018).

4. Fourth, promote gender-inclusivity in Disaster Risk Reduction. Inclusive disaster risk reduction recognizes the distinct roles and vulnerabilities of different groups, enabling more equitable and effective interventions.

   i) First step, ensure gender parity in all disaster risk management structures by requiring equal representation for women and youth in CBDRM committees.

   ii) Second step, tailor flood response interventions to the specific needs of women, girls, persons with disabilities, and the elderly (e.g., access to sanitation, maternal care, safety in shelters).

   iii) Thirdly, support women-led resilience initiatives, such as seed banks, savings groups, or household preparedness education, if any. Gender equality is a key determinant of community resilience, and inclusive DRR programs lead to better outcomes for all (UN Women, 2021).

5. Fifth, there is a need to enhance Coordination and Policy Support. Coordination among stakeholders remains weak in many flood-prone areas; however, strengthening the linkages between institutions and policy frameworks can ensure faster, harmonized, and effective flood responses.

   i) Actionable Steps are, first, to foster regular joint planning and coordination forums between the Relief and Rehabilitation Commission (RRC), county authorities, NGOs, and community representatives to align efforts.

   ii) Secondly, develop localized Flood Contingency Plans and enforce land-use regulations that limit construction in flood-prone areas.

   iii) Thirdly, advocate for the mainstreaming of community-based flood initiatives into national and state disaster policies, including resource allocation for grassroots DRM structures. Coherent institutional coordination is vital to bridge policy and practice and ensure thatlocal resilience is embeddedin national frameworks (World Bank, 2019).

6. Sixth, integrate Conflict Sensitivity and Peacebuilding into Flood Response. In Bor County, where social cohesion may be fragile, floods can exacerbate tensions over land, resources, and aid distribution. A conflict-sensitive approach is crucial.

   i) Actionable Steps should include, first, incorporating peacebuilding components into flood response programs by facilitating dialogue forums between clans and communities sharing flood-prone zones.

ii) Secondly, trained flood response actors on conflict sensitivity and do-no-harm principles, particularly when distributing aid or relocating popul ations.

iii) Thirdly, support community peace ambassadors or traditional leaders to mediate disputes and promote equitable sharing of flood defenses and safe spaces. Disaster responses must account for existing tensions and avoid unintentionally worsening local conflict dynamics (Safer World, 2017).

Limitations and Future Directions

While this study provides valuable evidence on community participation and the integration of indigenous knowledgein flood management in Bor County, several limitations should be acknowledged. First, the research was limited to qualitative data collected in four selected Payams (Baidit, Makuach, Anyidi, and Kolnyang). Although these areas are representative of flood-prone communities in the county, the findings may not fully capture the diversity of experiences across other Payams or counties in Jonglei State. Future researchers should therefore expand to larger geographic areas to enhance the generalizability of the results.

Second, the reliance on qualitative approaches, while useful for capturing rich narratives and community perspectives, restricts the ability to quantify the scale of participation and the measurable impacts of traditional knowledge on flood outcomes. A mixed-methods design that combines household surveys with qualitative interviews and focus groups could provide both statistical validity and deeper contextual understanding.

Third, this study did not incorporate hydrological or spatial modeling, which are critical for understanding flood patterns, water dynamics, and the potential effectiveness of community-led interventions. Future studies should focus on how to integrate geospatial analysis and hydrological modeling to complement local knowledge with scientific data, thereby offering more robust evidence for policy and planning.

Fourth, while gender representation was included in the FGDs and KIIs, the study did not undertake a systematic analysis of gender-specific roles, barriers, and opportunities in flood management. Given the central role of women in community resilience and resource management, future research should prioritize gender-sensitive approaches to better capture the differentiated experiences and contributions of women, men, and youth. Finally, the study relied partly on secondary documents, some of which had gaps or inconsistencies in data coverage. The future research should involve more comprehensive and up-to-date data collection, ideally in collaboration with local institutions, humanitarian agencies, and government bodies to strengthen accuracy and reliability.

In summary, advancing this line of inquiry requires broader sampling, methodological diversification, and deeper exploration of gender dynamics and scientific-climate linkages. Such approaches would not only strengthen academic knowledge but also provide actionable insights for policymakers, humanitarian actors, and local institutions working to improve flood resilience in South Sudan.

Conclusion

This study has revealed that community involvement is not only integral but indispensable to effective flood management in Bor South County, Jonglei State. The insights derived from

focus group discussions (FGDs) and key informant interviews (KIIs) reveal that local populations have cultivated a diverse array of coping and adaptive strategies rooted in their lived experiences, traditional knowledge, and collective action. These include traditional early warning practices, community-led construction of protective infrastructure, the mobilization of informal support networks, and the establishment of grassroots disaster management committees. Such efforts, while often informal and sometimes lacking institutional recognition, constitute the primary and most immediate form of flood response in many rural and underserved parts of South Sudan.

Despite limited access to formal disaster risk reduction (DRR) resources and weak institutional presence, the people of Bor South County have shown resilience and agency in managing rec urrent flood risks. Their active participation, often shaped by necessity and intergenerational knowledge, illustrates that community-based disaster risk reduction (CBDRR) can be highly effective, especially when external support is delayed or insufficient. This affirms the growing global consensus that sustainable and inclusive disaster management must be locally owned and culturally contextualized (UNDRR, 2015; Gaillard & Mercer, 2013).

However, the research also identifies a critical need to bridge the gap between formal disaster management institutes and local community structures. By integrating indigenous knowledge systems with scientific approaches and enhancing the capacity of local actors, government agencies, and humanitarian partners can significantly improve the effectiveness and timeliness of flood responses. Moreover, strengthening collaboration between the communities, local authorities, and external stakeholders will not only reinforce early warning and preparedness systems but will foster a sense of ownership, accountability, and shared responsibility.

In conclusion, re-cognizing and institutionlazing community participation is essential for building long-term resilience against flooding in Bor South County. Policies and programs aimed at disaster risk reduction must adopt a bottom-up approach that will empower communities as partners rather than passive beneficiaries. Only through such inclusive and context-sensitive strat egies can sustainable flood management and climate resilience be achieved in flood-prone regions of South Sudan and beyond.

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