



Stories from the Front Line: Coping Strategies for Flood Disasters among the Dinka Community of Bor County, South Sudan

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Abstract

The frequency of floods in Jonglei State, Bor County of South Sudan has significantly increased in recent times due to climate change. Bor County has the highest frequency of floods, making this area highly vulnerable. We conducted a qualitative study in five Payams of Makuach, Anyidi, Baidit, Kolnyang and Jalle. A total of ten Focus Group Discussions (FGDs) and twenty Key Informant Interviews (KIIs) were conducted. We used trained research assistants (moderator and note taker) to collect data. All research tools were initially translated to local Dinka language. All discussions were audio taped, and were transcribed verbatim before analysis. We explored both coping strategies and underlying causes of vulnerability. Data were analysed using latent content analysis through identifying codes from which basis categories were generated and grouped into themes. Results of the study show that the positive coping strategies used to deal with floods in Bor County included: adoption of good farming methods, support from government and other partners, livelihood diversification and using indigenous knowledge in weather forecasting and preparedness. Relocation was identified as unsustainable because people often returned back to high-risk areas due lack of public participation in decision making. The main causes of vulnerability were: poverty, lack of formal education, people inhabiting high risk areas, lack of formal education and knowledge on flood preparedness and, cultural beliefs affecting people's ability to cope. This study has revealed that deep rooted links to poverty, lack of formal education and low levels of knowledge on flood preparedness were responsible for failure to overcome the effects of floods in vulnerable areas of Bor County. However, support from the government and implementation partners was identified to be effective in enabling the community to reduce the negative effects of floods. This calls for high impact innovative interventions focused on addressing these underlying causes as well as public participation of all stakeholders in scaling

the effective coping strategies in order to build resilience in this Dinka community and other similarly flood affected areas of South Sudan.

Subject Areas

Environmental Sciences

Keywords

Bor County, Coping, Dinka, Floods, Underlying Causes, Payam

1. Introduction

It has now been acknowledged that climate change is having devastating negative impacts to the social fabrics of many communities in the Global South [1] [2]. The most vulnerable members of community have been disproportionately affected by the disastrous effects of climate change, thus perpetuating existing inequalities, thus propelling those with weak adaptive capacities into helpless conditions of vulnerability to shocks and stresses [3] [4]. As pointed out by ([1], pp. 977-978), this state of affairs is a pointer to existing socio-economic gaps, unequal power relations, poor governance and increased risks with limited ineffective adaptation and mitigation strategies. This buttresses the argument that those most vulnerable to the effects of climate change more often than not are voiceless when it comes to influencing and participating in policy making process [5]. In most cases, their day-to-day experiences associated with the vagaries of climate shocks are ignored in most interventions implemented by governments in the Global South [6]-[8]. This merely enhances their precariousness to vulnerability, even though they are the least contributors to emissions triggering climate change [9] [10].

South Sudan is one of the most vulnerable countries to the effects of climate change in Africa [11]. According to the 2021 Global Climate Risk Index, the effects of long drawn conflict, fragile formal governance institutions, coupled with the population's reliance on natural resources and rain-fed subsistence agriculture and pastoralism, make the country particularly vulnerable to projected climatic variations [12]. There is evidence that climate change is already exerting severe impacts on South Sudan, a nation already grappling with minimal adaptation strategies and constrained resources for addressing emergencies [13]. The catastrophic effects are ubiquitous across the states of South Sudan. On average rainfall has declined by 10% - 20% and temperatures have risen by more than 1 degree Celsius in the last 40 years [14]. Droughts and floods have become both more common and more severe, with 62% of the population surveyed by the National Bureau of Statistics in 2009 saying they suffered floods and droughts in the last 5 years [15]. Over the last four years, the country has been experiencing the most severe floods in living memory, displacing over half a million people and

contributing to one of the worst humanitarian crises the country has suffered [13]. Recent reports from the UN World Food Program estimate that about 8.3 million people in South Sudan faced extreme levels of hunger in 2022 due to a combination of floods, droughts, COVID-19, and conflict [11]. This is the highest number of persons exposed to extreme hunger since the country's independence in 2011, and perhaps the worst on record [13].

Studies have shown that South Sudan is one of the countries in the Greater Horn of Africa (GHA) region most susceptible to adverse impacts of the climate crisis [16]. This vulnerability is less likely to improve in the near future [17]. The climate change crisis is leaving a trail of devastation to different communities in different ways [18]. Smallholder farmers are paying a heavy price through low crop yields because of recurrent drought. On the other hand, pastoralists are seeing grazing lands for their animals dwindling in terms of area size and quality of pasture. Local communities have been displaced from their ancestral homes by devastating and incessant floods. For example, Jonglei State, which is inhabited by the Dinka Bor community, and the hardest hit in the country, had 174,000 internally displaced persons in 2021 alone as a result of floods [19]. Overall, inhabitants of this country are gazing into a bleak future as changes in climatic patterns and related effects are unearthing a host of other problems threatening the already fragile peace [11].

Climate change has adversely contributed to intense adverse flood effects on local communities in South Sudan. Given that the frequency of floods has increased in recent times [20], the above normal rains in 2019 triggered by the Indian Ocean Dipole (IOD) and climate change have caused long term effects [21]. The floods in 2020 were so intense that the waters did not recede in the intervening dry season. The implication of this is that with the prevailing waterlogged soil meant that subsequent rain translated to more rapid and severe floods in 2021, particularly in Jonglei, Upper Nile and Unity States. By October 2022, many areas relatively spared in 2021, including in Northern Bahr el Ghazal, Warrap and Western Equatoria States, had also been inundated with flood water [22]. It is estimated that approximately 2.6 million people had been affected by December 2022 [22]. The same pattern was experienced in 2023, the country's fifth consecutive year of historic flooding, although fewer people appear to have been affected [23]. It has been suggested that floodwaters covering the worst affected areas, such as around Bentiu in Unity State, are not predicted to drain fully until 2028 [24].

In sub-Saharan African (SSA) countries particularly, fragile states like South Sudan, individuals, households and local communities have come up with some innovative local coping strategies to climate related shocks like floods. It is acknowledged that coping strategies are a combination of all the strengths, attributes and resources available within a community, society or organization that can be used to avert some or all of the negative effects of a shock or stress [25]. For example, some strategies may include: migrating to safer grounds if the threats are too averse to ignore, receipt of aid and relief, and resorting to subsistence and

innovative farming practices such as terracing in order to overcome crop destruction following heavy rains [25]. In South Sudan, the Ministry of Humanitarian Affairs and Disaster Management Strategic Plan 2018-2020 for disaster preparedness and management addresses some key coping issues such as resettlement of people living in high-risk areas, applying appropriate farming technologies and prohibition of settlement in high-risk areas. However, implementation of the strategic plan remains a mirage because of ([26], p. 5):

- Absence of trained and skilled personnel in the field of Early Warning and Early Response (EWER) mechanisms, and
- Lack of working tools and equipment for detecting threats, for example, floods and drought

Under the prevailing climate shocks, it is postulated that flood occurrences will increase in frequency and local communities in South Sudan will become more exposed. To the best of the researcher's knowledge, there is very limited knowledge on coping strategies and underlying causes of vulnerability to the effects of floods among the Dinka community in Bor County, South Sudan. The purpose of this study was therefore to elucidate the critical issues surrounding flooding in Bor County, in particular, the local community's coping strategies.

2. Conceptual Framework Underpinning the Study

Climate shocks impact coping and adaptation strategies in a given geographical space are by and large determined by the degree of vulnerability within a given setting and the mental perceptions of climate change as a phenomenon. Scholars like ([27], p. 328) opine that "vulnerability is the ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being". On the other hand, ([28], p. 499) view vulnerability as "a set of socio-economic, political and physical factors that determine the amount of damage a given event will cause", while ([29], p. 623) sees vulnerability as "the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of a community to the impacts of hazards". Hufschmidt's assertion converges with that of [30] submission that vulnerability must be related with a specific hazard or set of hazards so that vulnerability and exposure in the context of climate change become inseparable [31]. We may logically conclude that vulnerability to climate change and other environmental related events are somewhat socially, economically and politically constructed and not natural [31]. Social construction of vulnerability as used in this study, is borrowed from ([27], p. 329) and refers to how different socio-economic and political characteristics, processes or trends (including knowledge on climate change) influence levels of vulnerability. In a nutshell, "vulnerability is a function of sensitivity and exposure of a system to changes in climatic conditions (*i.e.* the degree to which a system will respond to a given change, including both beneficial and harmful effects, based on knowledge and understanding of such changes), and the ability to adjust the

system to enable it cope and adapt to hazards that come with changes in climate” ([31], p. 298).

Coping, as used in this study, refers to a spontaneous response to unusual weather or climate events as pointed out by Berkes and Jolly [32]. According to Davies [33], coping processes are a conglomeration people’s immediate responses to climate shocks. Such processes either take the form of emergency at the individual or household levels. Borrowing from ([33], p. 62), “coping mechanisms and strategies are a bundle of people’s immediate responses to adverse effects of climate-induced events”. Overall, such responses mimic forms of emergency and panic responses of individuals and households to abnormal weather conditions and or sum total of climate-induced events. In the context of climate shocks, coping, by definition and application, is a temporary response to climate-induced impacts on livelihoods without any fundamental or structural changes to systems and institutions [31].

This study further draws heavily from the concept of human capital to advance the notion that knowledge on climate change and local interpretations, to some extent, can influence coping processes. Scholars like [34] [35] take human capital as an investment in education (both formal and informal), health and nutrition of individuals for sustainable growth and development. [36] argue that the degree to climate change related events will bring human misery in the future depends on people’s knowledge and understanding of climate change. Human capital, which centrally revolves around knowledge acquisition through education (both formal and informal), can thus play a crucial role in ameliorating some of the negative impacts of climate shocks in various ways. For example, [37] observe that climate literacy is one of the key pathways through which communities can access knowledge, competencies and skills that could enhance their coping capacity. In other words; “climate knowledge, general life skills and abstract thinking can give better understanding and the ability to internalise risk information about weather forecast and warning messages” ([36], p. 43). Thus, when disaster occurs (in this case, climate shocks), “climate-educated” individuals might be more ready to respond and act upon the event than their “uneducated” counterparts [31]. Human capital, which centrally revolves around knowledge access through education (both formal and informal), can thus play a crucial role in ameliorating some of the negative impacts of climate shocks. [37] indicate that climate literacy is one of the primary pathways through which communities can acquire knowledge, competencies and skills that could boost their coping capacity. In other words; “climate knowledge, general life skills and abstract thinking can give better understanding and the ability to internalise risk information about weather forecast and warning messages” ([36], p. 43).

Finally, it is acknowledged that an appropriate human capital foundation (knowledge) influences people’s risk and vulnerability perceptions. If people perceive their risk with regard to climate shocks to be real by virtue of their climate literacy, they are more likely to plan in advance for such risks and cope

accordingly. Thus, according to [38], risk awareness through education can contribute immensely towards climate change risk and vulnerability reduction. In the context of South Sudan, Human capital is a panacea in gauging peoples' level of awareness about climate change, in relation to local perceptions of the same and their coping strategies.

3. Materials and Methods

3.1. The Study Area

The study was carried out in the County of greater Bor (**Figure 1**) which has six (6) Payams (lowest administrative unit), namely: Makuach, Anyidi, Baidit, Kolnyang, Jalle and Bor Town in Jonglei State. Bor is the capital of Jonglei state. According to [39], the County occupies an area of about 120,000 km² characterised by flat plains, clay soils, prone to flooding. Bor borders the states of Eastern Equatorial, Lake State, Twic East County, and Pibor County. The County has an approximate population of 350,000 people and hosts the state capital [39]. Bor is politically and geographically important to the country in relation to the history of conflicts in South Sudan. Communities in Jonglei derive their livelihoods from

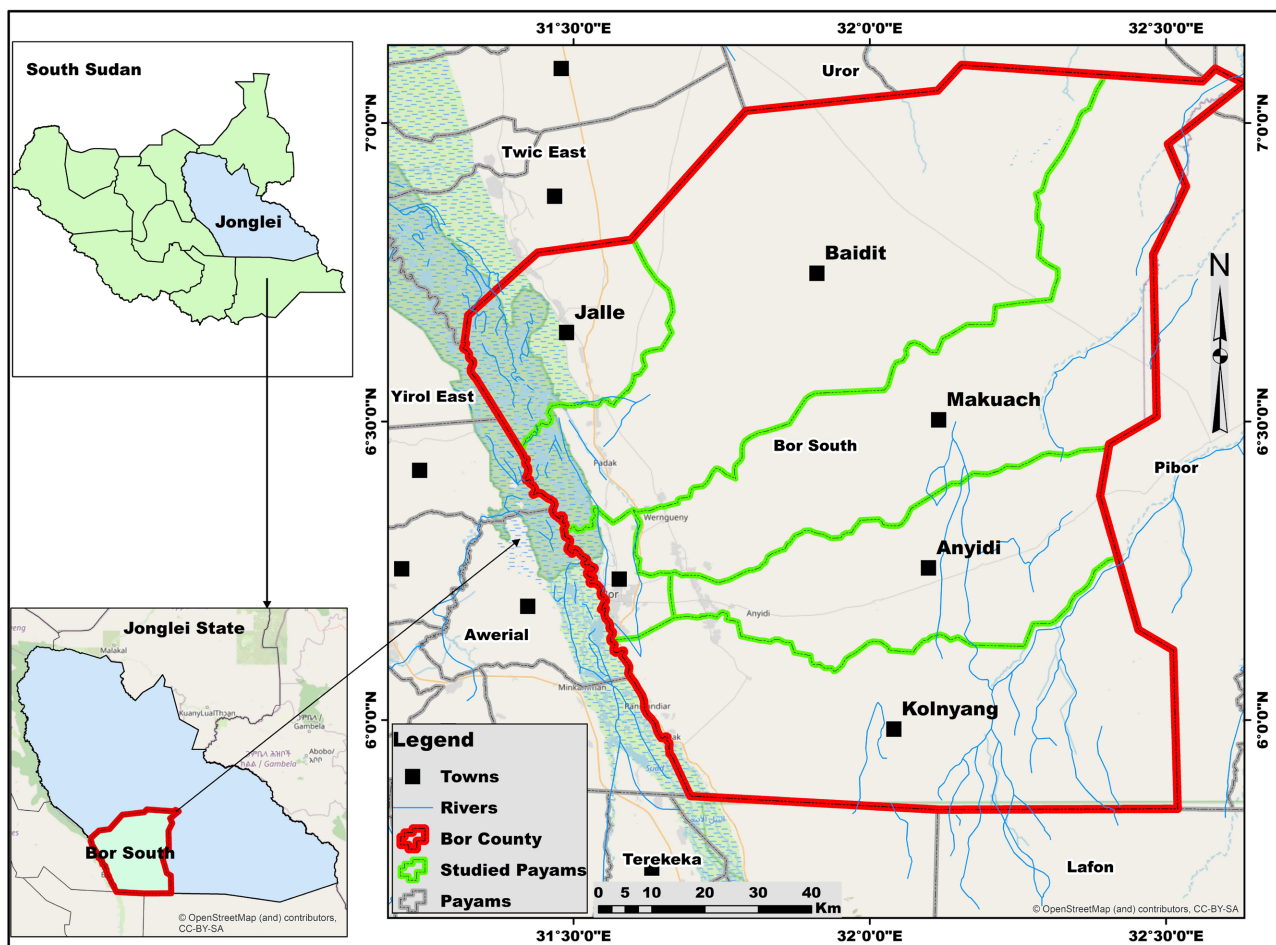


Figure 1. Study area location (Source: Authors).

pastoralism, farming and fishing. In a normal year the County has four seasons. These are January to March (dry, hot, clear skies and temperatures of between 40°C to 45°C; April to June (heavy rains, light cloud cover, heavy westerly winds and temperatures between 36°C and 39°C); July to September (heavy rains, flooded and muddy lands that are often impassable, high humidity and temperatures between 30°C and 35°C); and October to December (light rains, clearer skies and temperatures of between 20°C and 30°C) [39]. The county experiences shortage of water and green pastures from February to April which at times triggers conflicts over access to grazing lands [39].

3.2. Study Design

We conducted a qualitative study that used Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). FGDs and KIIs were best suited to explore underlying causes of vulnerability and the coping strategies for floods in Bor County, South Sudan.

3.3. Selection of Study Participants

The study employed a mixed-method approach that combined quantitative and qualitative methods. These methods were triangulated to validate the findings of the study. The qualitative approach employed focus-group discussions, observations, questionnaires and in-depth key informant interviews, which helped the researcher to delve deeper into getting more information that could hitherto not be obtained through household surveys. A total of 609 respondents (402 males and 207 females) participated in the study (a figure at which a theoretical saturation point was reached). Hsieh and Shannon [40] indicate that theoretical saturation occurs when the researcher establishes that no new or relevant data seem to be emerging from the respondents, and that enough applicable information has been gathered to satisfactorily answer the research questions. The respondents were selected through a combination of probability (simple random) and non-probability (purposive) sampling methods. The focus persons for the questionnaire administration and interviews were residents (male or female) older than 40 years. Participants from each focus group had both males and females. Given that gender did not influence behaviour as regards disasters, both males and females were interviewed in the same focus group [25]. It became evident during the focus-group discussions that local and cultural interpretation of climate change is not general knowledge, but is related to the length of time a person has been living in an area, direct experience and the socio-cultural embedment of the person. The older persons (40 or above) were found to capture these key variables—long-term direct experience and socio-cultural embedment—hence their appropriateness. As a qualitative study, the selection of the sample size was not based on established statistical methods and procedures; it was rather determined by the principle of theoretical saturation. A content-analysis process was used to analyse the data by first coding the major themes that emerged.

A total of 160 participants were involved in the 10 FGDs. The FGDs were drawn from the community members, mainly opinion leaders, political leaders, cultural leaders and other categories of individuals who had a good knowledge of the development challenges in Bor County. All participants were aged 40 years and above. Participants from each focus group had both males and females. Given that gender did not influence behaviour as regards disasters, both males and females were interviewed in the same focus group [25]. FGDs participants were from rural communities worst affected by floods. We also conducted 10 KIIs with County Technical Officials, representatives from NGOs and district Political/Opinion/Religious leaders and Chiefs from Payams.

3.4. Data Collection

The focus of the study was resilience which dealt with the capacity of people and systems to mitigate, cope positively, recover and learn from shocks and stresses in a manner that reduces vulnerability and increases well-being [25]. The target Payams for this study were: Anyidi, Baidit, Jalle, Kolnyang and Makuach – the most affected in Bor County. We conducted two FGDs in each of these Payams. Each FGD had a total of 10 participants. We recruited research assistants who also had a good working knowledge of English, and the local languages, and trained them on the study protocol and procedures. The survey questionnaires were translated into the local language and pretested in a similar setting in order to get feedback on questions that were not clear. This was done prior to data collection. Investigators also participated in the data collection process. During interviews we asked open ended questions followed by targeted questions on predetermined categories. The interview guide focused on factors that empower communities to resist disasters and underlying factors that make communities fail to overcome their vulnerabilities (probing for people, physical infrastructure, livelihoods infrastructure and institutions). The FGDs and KIIs were audio recorded with consent.

3.5. Data Management and Analysis

The FGDs and KIIs were all transcribed verbatim and those in the local languages translated without altering the meaning. A conventional content analysis approach was used as described by [40] with codes and categories arising from the data. Analysis was done in two stages, first, the manifest content analysis and then the latent content analysis. The transcripts were read and back translated by the authors to achieve immersion. Text data was read to derive codes by highlighting emerging factors based on our comprehension of the data. Codes were formulated and sorted into categories based on their linkages. The categories were grouped together into meaningful overarching themes *i.e.* coping strategies and underlying causes of vulnerability to the effects of floods. Strategies that improved long term vulnerability of individuals, households and communities were categorised as positive coping while those strategies that had no impact were put under the category of unsustainable coping [25].

3.6. Ethical Considerations

Ethical clearance was obtained from Kenyatta University Ethics Committee (PKU/2578/I1704). The objectives, benefits and risks of the study were explained to the study participants and their informed consent obtained prior to commencement of data collection. All data obtained during the study were treated with confidentiality and anonymity. We restricted data access to only the investigators and the research assistants.

4. Results and Discussion

4.1. Demographic Characteristics of the Respondents

The demographic characteristics of respondents are shown in **Tables 1(a)-(c)**. From **Table 1(a)**, 66% of the respondents were male and 34% were female. The distribution of respondents by sex per Payam is shown in **Table 1(b)**, while the distribution of education level of respondents is shown in **Table 1(c)**. The gender variable sex in our study was considered important because women, men and children experience climate impacts differently depending on where they live, how they sustain their livelihoods, and the roles they play in their families and communities. On the other hand, level of education is important in selection of climate change coping strategies as pointed out *inter alia* under the conceptual framework section.

Table 1. (a): Sex of respondents; (b): Distribution of respondents by sex per Payam; (c): Level of education of respondents.

(a)		
Respondents sex	Frequency	(%)
Male	402	66.01
Female	207	33.99
Total	609	100.0

Source: Field survey data (2023).

(b)			
Name of Payam	Male	Female	Total per Payam
Anyidi	84	40	125
Baidit	42	39	81
Jalle	41	60	101
Kolnyang	154	42	196
Makuach	81	26	107
Total	402	207	609

Source: Field survey data (2023).

Continued

(c)		
Level of education	Frequency	(%)
No formal school attended	295	48.44
High school	95	15.6
University	79	12.97
College	54	8.87
Primary school	48	7.88
Pre-primary school	30	4.93
Adult education	8	1.31
Total	609	100

Source: Field survey data (2023).

4.2. Climate Change Awareness and Impacts in Bor Community

Even though climate change is globally acknowledged, its spatial impact is contextually specific and differs across regions, countries and local communities. Thus, differentiating and understanding these spatial impacts, must be brought to the fore and for that matter contextualised. Against this backdrop, we investigated in this study the research participants' understandings of climate change and its impacts on Dinka Bor community. In this regard, a question requiring research respondents to indicate their knowledge of climate change was asked, and their responses are presented in **Table 2(a)** and **Table 2(b)**.

Table 2. (a): Male participants' knowledge of climate change and impacts in Bor community; (b): Female participants' knowledge of climate change and impacts in Bor community.

(a)				
Type of response	Knowledge of existence of climate change	(%)	Knowledge of climate change impacts on Bor community	(%)
Yes	394	98	380	94.5
May be	7	1.8	8	2.0
I don't know	1	0.2	10	2.5
No	0	0	4	1.0
Total number	402	100	402	100

Source: Field survey data (2023).

(b)				
Type of response	Knowledge of existence of climate change	(%)	Knowledge of climate change impacts on Bor community	(%)
Yes	196	94.7	200	96.6

Continued

May be	8	3.9	5	2.4
I don't know	3	1.4	2	1.0
No	0	0	0	0
Total number	207	100	207	100

Source: Field survey data (2023).

Table 1(a) and **Table 1(b)** show that over 95% of the male and female respondents expressed knowledge of climate change, with same percentage indicating to have knowledge of impacts of climate change on their Bor community. A follow up question asked participants whether they have an understanding of the manifestation of extreme weather event(s) that constitute climate change shocks (**Table 3**).

Table 3. Observed impact of climate related extreme weather events in Bor community.

Impact of extreme climate related weather event	Cumulative number of responses	(%)
Flooding	240	39.4
Drought	60	9.9
Insufficient clean water	50	8.2
Loss of pasture	50	8.2
Increased human diseases	49	8.0
Increased livestock diseases	40	6.6
Reduced agricultural yields	30	4.9
Deterioration of socio-economic conditions	30	4.9
Destruction of the roads	20	3.3

Source: Field survey data (2023).

The data in **Table 3** shows that about 39% of the respondents isolated flooding as a factor of climate change, while 9% and 8% of the respondents alluded to drought and insufficient clean water supply as a direct attribution to climate change, respectively. It can be deduced from **Table 3** that the combined impacts of climate change on livelihood supporting systems in Bor community is estimated to be about 51% of the total responses.

4.3. Livelihood Diversification

The results from this study demonstrate that as much as the local community in Bor County is ravaged by climate change induced floods, they are not sitting passively. They have embraced a cocktail of actions to adapt to the vagaries of climate change. Focus Group discussions and key informants described a number of

coping strategies that have been used by individuals and communities to lessen the effects of landslides and floods. Gukurume [41] defines livelihood diversification as a process by which rural households embark on diversification of a portfolio of activities and social support capabilities for survival and in order to improve their standard of living. This study established that agricultural activities in all Payams of Bor County are severely affected by floods. This is manifested in crop destruction and severe soil erosion. Several participants during FGDs and key informant interviews reported employing a diversity of actions to sustain their livelihoods under these circumstances. From the narrations provided by the participants and observations made by the researchers, it is evident that most households are engaging in a cocktail of livelihood activities and diversified income portfolios. The following statements confirm this:

Farming in this place has become so unpredictable and if we don't do something within our means, we are going to starve to death! I do so many other side hustles like charcoal burning and selling in order to bring food on the table and also take my children to school (FGD, Female, Anyindi, Baidit and Jalle Payams).

We are hustling our way out of this perennial situation by doing a lot of things to feed our families. There is nothing coming out of these fields (KIIs, Female, Kolnyang and Makuach Payams).

Some of us have established retail shops outside Bor town, so when our crops are destroyed by the floods, we survive on income from these shops. We also acquire some money to pay for school fees for our children and when they finish and get employed, they support us especially in the event of floods (FGD, Female, Anyidi, Makuach Payams)

The researcher argues that selling of charcoal through cutting of trees is contributing to environmental degradation in South Sudan and Bor County in particular [42]. Participants during FGDs reported that the scale of charcoal production has increased dramatically in recent years, particularly with the extensive use of chainsaws to fell trees, compared to traditional methods using axes. One KII respondent quantified the difference by observing that where there used to be 10 charcoal sacks, there are now 100! (KII, Makuach Payam). This is a clear demonstration of the magnitude of environmental degradation through charcoal production in South Sudan and the study area in particular.

4.4. Use of Indigenous Local Knowledge Systems (ILKS)

Indigenous and Local Knowledge Systems (ILKSs) is a term used to describe the wisdom, techniques, approaches, skills, practices, philosophies, and uniqueness of knowledge within a given culture, which is developed by local communities over years through the accumulation of experiences and informal experiments, and based on an intimate understanding of local contexts [18] [43]. This study established that ILKSs are useful to inform adaptation strategies devised by rural communities in the five Payams studied. These traditional coping strategies are largely

based on experience that have been accumulated over the years and transmitted from one generation to the other. The following narration confirms this:

God has given me the gift of being able to predict whether floods or drought are going to visit our community by observing the behaviour of certain plants and wild animals. This will inform us whether to move away from this place or if we stay because the season will be good for our crops (KII, Male, Baidit Payam).

The researcher emphasizes that rural communities have over time developed innovations of gathering, predicting and arriving at conclusions related to weather [43]. The following excerpt was extracted from key informant interviews with traditional Payam leaders who are believed to be custodians of ILKS.

We predict good and bad farming seasons through analysing the direction of the moon (facing north) symbolized start of planting season. Black ants (termites), the visibility of too many black ants indicated that it was a rainy season, so we know we could plant. (KII, Male, Kolnyang and Anyidi Payams). Different colours of clouds and how high in the sky they are could tell if it is going to rain the following day. A circular halo around the moon is taken to mean that heavy rains are expected and floods will ensure during the rainy season beginning from July - September (KII, Male, Makuach Payam).

We wish to point out that various ILKSs are traditionally applied in harmony with the natural and spiritual realm. These socio-cultural practices are resourcefully designed to address local ecological limitations by maintaining a sustainable utilization and protection of commonly shared natural resources [44]. Most respondents during the FGDs reported that ILKSs are very crucial in their daily lives and play a very crucial role in providing indigenous early warning systems that are a pillar of decision making regarding impending climate shocks [45] [46].

4.5. Harnessing of Social Capital

Social networks such as friends and family could affect the community's attitude about climate change adaptation [47], enrich their knowledge on the adaptation [48], modulate their willingness to implement adaptation technologies and increase their capacity for estimating potential risks and damages caused by climate change [49]. From the narrations submitted by participants, we could deduce that the inhabitants of the Payams studied are embracing social capital amidst climate-change-induced shocks. In this study, we operationalise social capital to refer to a web of networks created through social interaction that reinforces trust and mutual benefit [41]. We observed an array of relationships between community members fostering social cohesion, solidarity and unity during climatic-induced shocks, such as floods. This network of relationships allows the community to cushion themselves against the effects of successive episodes of floods, share scarce resources such as fresh water, and adopt a collective community disaster rescue plan. The following excerpt from the field confirms this:

We try to hold each other's hand during difficult times of floods and drought as a community. This togetherness is really keeping us moving on with our lives. We cannot die of hunger when my neighbour has food. Last time my homestead was destroyed by floods, our neighbour from the areas not affected by floods accommodated my family for many months (FGD, Female, Jalle).

We argue that social capital is somewhat enhancing a sense of unity of purpose and community cohesion and social networks are providing a unique adaptation resource to Bor community. The existing social community groups are playing a critical role in disseminating crucial information for mitigating floods. The following narration confirms this:

We compare notes on daily basis on our survival tactics in the midst. We have formed community groups where we share knowledge and new information about the challenges that confront us and how we can empower ourselves to address them (FGD, Male, Anyidi, Makuach).

The above narration bears testimony to the significance of social capital as an adaptation strategy to climate change in rural communities. [50] note that social capital fostered through trust and cooperation amongst rural households and communities is essential for climate change adaptation. The reason for this is that other components of adaptation actions require enormous inputs compared to social capital that is embedded in communal social networks.

4.6. Outmigration and Infrastructure Development

From a resilience point of view, some of the coping strategies mentioned in managing floods in Bor County were not effective in ameliorating the negative effects of these disasters hence inappropriate. These included infrastructural construction and rehabilitation and relocation of local community populations to areas with higher ground relief. Narrations from all of FGDs mentioned infrastructure maintenance such as community road maintenance, creation of water channels, digging trenches and sealing river banks to be unsustainable in reducing the effects of floods. They explained that these disasters still come and destroy everything on their way. The following account attests to this:

We have tried to dig trenches but it has failed because when the waters come, the area still floods. Even when we try to raise up the roads, the roads still flood. (FGD, Male, Jalle, Makuach)

In the past, the government tried to relocate people from flooded to Mangala, but they never stayed there long. They came back within no time because of their inherent strong traditional beliefs. (KII, Chief, Makuach Payam)

There was no community participation in decision-making. They never tried to find out what people wanted and deemed okay from their perspective. They thought they can think for the community and so they decided to take them to Mangala (relocated) and they were not prepared for such. Even if it

was me, I would not stay there. (KII, Male Elder, Jalle Payam)

Even though two thirds of the FGDs mentioned relocation to higher ground as a positive coping strategy, five key informants were concerned about its effectiveness pointing out that some of the relocated people often returned back to high-risk areas due some factors like cultural attachments, funding challenges and failure to involve and consult the community in prior planning of the relocation. Elsewhere, these internally relocated people have been referred to as “climate migrants” – meaning persons who are compelled to move from their homesteads as a results of climate shocks like floods [51]. There is abundant empirical evidence available indicating that migration is a common coping strategy for households in order to reduce their vulnerability to climate change related shocks [52] [53].

4.7. Underlying Causes of Vulnerability to Floods in Bor County

Many of the factors which exacerbate vulnerability to the effects of floods in Bor County are mainly socio-economic and cultural in nature. The main economic causes that emerged from the FGDs and KIIs were, poverty, lack of formal education, construction of weak houses using indigenous materials, limited land, population pressure and lack of access to critical infrastructure and services. Consistently across all FGDs and KIIs, the issues of poverty and lack informal education were highlighted as the main cause of vulnerability for floods. For example, it was pointed out that some communities did not have resources to come up with simple measures or innovations to reduce the effects of floods. Poverty and lack of formal education were linked to the non-durable informal structures of houses that were being constructed. Ten of the key informants mentioned that the houses were constructed using poor quality materials and therefore could not resist destruction from floods.

They (community) are powerless because they are poor, lack formal education and they cannot afford to put in place technologies, they don't even have trained labour force, you don't have the resources because labour is expensive so that alone (poverty) is the biggest hindrance. (KII, Male Elder, Makuach Payam)

The materials they used are not good, in other words the contractors do shoddy work. They bribe their way to get these jobs. When the river floods, automatically the water will come and sweep away the structures because of the weak foundation. (KII, Female from NGO, Jalle Payam)

The main social causes of vulnerability that emerged were lack of knowledge on flood preparedness and strong cultural beliefs among community members. Half of the FGDs mentioned limited knowledge about disaster preparedness and mitigation in increasing the community's vulnerability to floods. In addition, four FGDs mentioned the influence of strong traditional beliefs in making people fail to overcome their vulnerability e.g. settling in high-risk areas reported to be their ancestral homes. The following narrative supports this view:

We are very primitive and do not know what to do to arrest these problems. This problem can also be attributed to the fact that our children are very low in education. They have very low comprehension of required skills that would help us prepare to address this floods problem. (FGD, Female, Baidit Payam)

When all is said, this can be associated with deep rooted cultural beliefs. For example, I know of some old man from my Anyidi Payam that said that his grandparents and parents were buried here and so he was going nowhere else but rather stay in his ancestral lands until he dies. (FGD, Male, Anyidi Payam).

Studies confirm the above narrations that South Sudan lacks knowledge and expertise in flood risk management, environmental studies, and emergency management [54]. The lack of knowledge lends support to the conceptual framework underpinning this study that opines that knowledge on climate change and local interpretations, to some extent, can influence coping processes. Consequently, South Sudan's critical infrastructure regarding drainage systems, dams, urban planning, and levees is severely underdeveloped [54]. The mismanaged governmental system, resources, and tribalism prevent meaningful progress in disaster management mitigation. Most progress in this area is only achieved with the help of NGOs and consequently, local communities are usually left on their own when floods occur [55].

5. Conclusion

The study has established that coping strategies are pivotal towards the amelioration of adverse effects of floods. From the results obtained, vulnerabilities of men and women have been isolated as determinant factors associated with flood risks in Bor County. The coping strategies identified include: livelihood diversification, use of indigenous local knowledge systems, harnessing social capital, outmigration and infrastructure development. The study reveals that the underlying causes of vulnerability to floods in the study area are mainly due to deep rooted links to poverty, low levels of formal education, deep rooted cultural attachments and lack of awareness. Disaster Risk Reduction (DRR) is a new field of knowledge in the study area. This calls for support in designing targeted interventions targeting reduction of the identified underlying causes of vulnerability besides the involvement of all stakeholders in scaling the effective coping strategies in order to build resilience in this community and other similarly affected Payams. This would go a long way in achieving overarching objective of environmental democracy which is a tripartite of the so-called "access rights" in environmental matters, namely: access to information, participation in decision-making, and access to justice.

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Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Kenyatta University Ethics Review Committee.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data that support the findings of this study may be available on request from the corresponding author. These data are not publicly available because of agreements made with the participants as well as the Kenyatta University Ethics Review Committee.

Conflicts of Interest

The author declares no conflict of interest. The funder had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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