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Research Article

Advanced Assessment of Socioeconomic Impacts Resulting from Flooding: A Case Study of Beledweyne, Hiran, Somalia

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Abstract

Floods are one of the world›s most devastating natural disasters, and their risk is expected to increase remarkably in socioeconomic conditions. Yet, more detailed and consistent data on the flood vulnerability to socioeconomic conditions scared. The socioeconomic impacts of floods in Beledweyne, Hiiraan, Somalia, to report effective disaster management strategies and enhance community resilience. A descriptive research design employs a mixed-methods approach, utilizing questionnaires and key informant interviews to collect data. The findings reveal a high degree of awareness among the community and a widespread perception of the severity of the flood, resulting in a significant loss of income. The community advocated more excellent investment in flood infrastructure, education, technical assistance, and strengthening community organizations to improve flood resistance in Beledweyne. Diverse challenges in post-flood agriculture are highlighted, alongside proactive efforts by the affected community. In addition, the study highlights the diverse set of efforts, including government-led programs, nongovernmental organizations (NGO) projects, community-based initiatives, and international aid, all directed towards mitigating flood vulnerability and enhancing the community›s resilience. Immediate resilience measures are required, such as early warning systems, disaster preparation, sustainable land use, improved agriculture, and community cooperation. To overcome the challenge, a collaborative approach is required from national and regional governments, agencies, and scientists to offer actionable insights and implement disaster management approaches for the socioeconomic uplift of communities on a sustainable basis.

Keywords: DFlood Impact Assessment, Socioeconomic, Livelihood Effects, Community Resilience, Sustainable Development.

1. Introduction

Floods are one of the major causes of human and environmental disasters. It has an impact on socioeconomic stability, declines public health, causes unemployment, and harms the environment and its associated long chain of factors [1]. Overall, river floods account for approximately 50% of all deaths and 33% of all financial losses from natural disasters worldwide [2]. Recently considerable facts notified about the last decades, river floods killed over 112,000 people, impacted over 354 million people, and caused around 520 billion Euros (US$690 billion) in financial harm in Africa [3]. Floods are also caused by multiple factors, including surcharges in water levels caused by natural or man-made construction on flood plains, sudden dam failure, inappropriate land use planning, mudflow, insufficient drainage capacity, snowfall, and catchment basin deforestation [4]. Global corresponding approach to the point its mandatory to reduce the effects of floods has become a public problem of worldwide attention, as expressed in several international treaties such as the Millennium Development Goals (MDGs) and now the Sustainable Development Goals (SDGs). The primary causes impacting the prevalence of flooding have been attributed to the world's population growth rates and socioeconomic activities in flood-prone areas. Furthermore, the developing challenges related to climate change have been referenced as relevant among other variables [5].

Many countries in Sub-Saharan Africa (SSA) lack climate adaptation strategies and policies to handle the increasing frequency of natural disasters. There is an urgent need to develop plans to reduce the negative health impact of meals. The failure to prepare raises serious concerns about

the future illness burden in SSA [6]. The flood flats of the Benue River in Adamawa State are an ideal geographical location for a variety of economic activities and stability, particularly in the sector of farming and fishing. These traditional livelihoods are interrelated and spatially tied to the immediate villages and the greater Adamawa State. The connection between livelihoods and communities is frequently impacted by floods due to their considerable effects on transportation [4].

Somalia has seen powerful river floods regularly, causing massive losses when the floods reach the town center [7]. Flooding of the Juba and Shebelle rivers is likely to be caused mostly by discordant climate shifts and inconsistencies in anthropogenic cycles. Floods are most common during the stormy seasons of Spring (April to June) and Autumn (October to December), and the progression of the rivers is most noticeable currently. This is also when heavy rains occur within the catchment area of all rivers in the Ethiopian Highlands [2].

Floods in Somalia were shorter in duration in 2000, 2002, and 2005. Heavy and moving precipitation in the upper catchments of the two rivers caused these floods. In the Spring season of 2005, floods were the most noticeable. This season, floods were primarily caused by heavy rains in the Ethiopian highlands that fell on the catchments of the two bowls [8].

In Somalia, flash floods are a common occurrence, because the most prominent devastating flash floods have occurred in recent decades, causing major challenges for residents living near the Shebelle and Juba rivers. The residents of Beledweyne City were severely impacted. Thus, the study aims to unravel the intricate web of impacts that floods unleash on communities, infrastructure, livelihoods, and well-being in Somalia, and ultimately, provide the knowledge needed to develop effective strategies that mitigate the adverse socioeconomic effects of floods and promote sustainable development to stakeholders, policymakers, and disaster management agencies.

2. Materials and Methods

The study employed a descriptive research design that combines qualitative and quantitative approaches to gather data on a specific phenomenon at a particular time. It utilized a cross-sectional survey methodology, observing a large group simultaneously due to time limitations common in academic research projects. The population of the study consisted of 255 participants residing in Beledweyne and its surrounding areas, including farmers, business owners, community leaders, and displaced people who had experienced floods. A sample size of 156 participants was selected due to resource constraints.

Beledweyne is situated in the Hiran region which is 210 miles (345 km) north of Mogadishu the capital city of Somalia. Beledweyne is divided by the Shebelle River into eastern and western sections. Beledweyne was selected as the study region because it has seen frequent flooding for the past 20 years, making it a flood-prone area. The geographical coordinates of Beledweyne are 4° 45’ 0” North, and 45° 12’ 0” East.

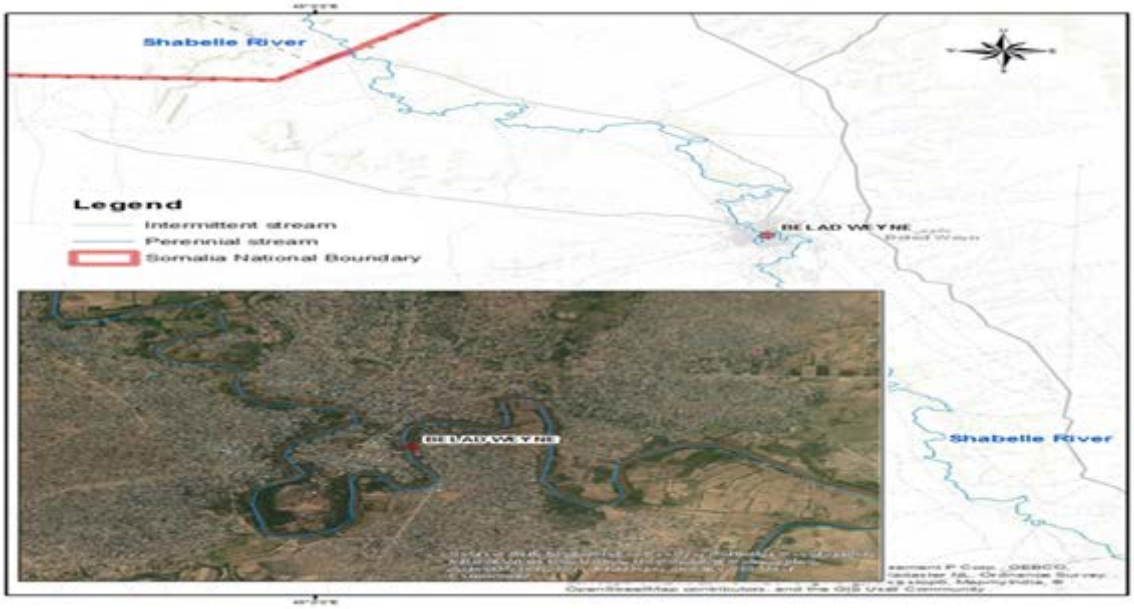

Figure 1: Location Map of Beled Weyne Showing how the River Encircles the City.

The sample size determination was based on Sloven's formula, resulting in 156 participants selected from the target population of 255 [9].

$$n = \frac{N}{1+N(e)2} = \frac{255}{1+255(0.0025)} = 156$$

Where;
n = Size of the sample
N = size of the population
e = significance level, estimated at 0.05

Purposive sampling was employed to select participants based on the researcher's judgment, and a questionnaire was developed as the data collection instrument. Data collection involved questionnaires and interviews, with a preference for questionnaires due to the efficiency in collecting information over a short period. Survey interviews were conducted on individuals or groups randomly selected. Data analysis was performed using percentages, with the SPSS software employed for quantitative analysis. The use of quantitative methods was justified for summarizing bulk data, analyzing multiple variables, and providing an easy way to interpret questionnaire data. Tables and percentages were utilized to present and interpret the findings [10-20].

3. Results and Discussion

According to Cardona et al. (2012), flood vulnerability is influenced by various factors, including social, economic, geographic, demographic, cultural, institutional, governance, and environmental aspects. These factors exhibit temporal and spatial dynamics, reflecting the evolving nature of flood vulnerability, exposure, and resilience over time and across different geographical areas. Moreover, the determinants of flood vulnerability are subject to change, highlighting the necessity of considering updated information when assessing these factors [21].

Table 1: Demographic Information of the Respondents

Variable	Number of respondents (Frequency)	Percent of respondents (%)
(a) Gender		
Male	119	76
Female	37	24
Total	156	100
(b) Age		
18-25	24	16
26-35	49	31
36-45	59	38
46 and above	24	15
Total	156	100
(c) Education		
Primary/Secondary	17	11
Bachelor's degree	58	37
Master's degree	53	34
Non-formal education	28	18
Total	156	100
(d) Marital Status		
Married	102	65
Single	54	35
Total	156	
(e) Occupation		
Farmer	38	24
Business owner	55	35
Community leader	17	11
Displaced person	46	30
Total	156	100

The demographic information reveals that among the total respondents, 76% identified as male, while 24% identified as female. In terms of age distribution, the highest percentage, 38%, falls within the 36 to 45 age bracket, followed by 31% in the 26 to 35 age range. Respondents aged 18 to 25 constituted 16%, and those aged 46 and above made up 15%. Regarding education, 37% of respondents held bachelor's degrees, 34% had master's degrees, 18% had non-formal education, and 11% had completed only primary or secondary school. Most respondents, 65%, identified as single, while 35% reported being married. Business owners formed the largest occupational group at 35%, followed by displaced individuals at 30%, farmers at 24%, and community leaders at 11%.

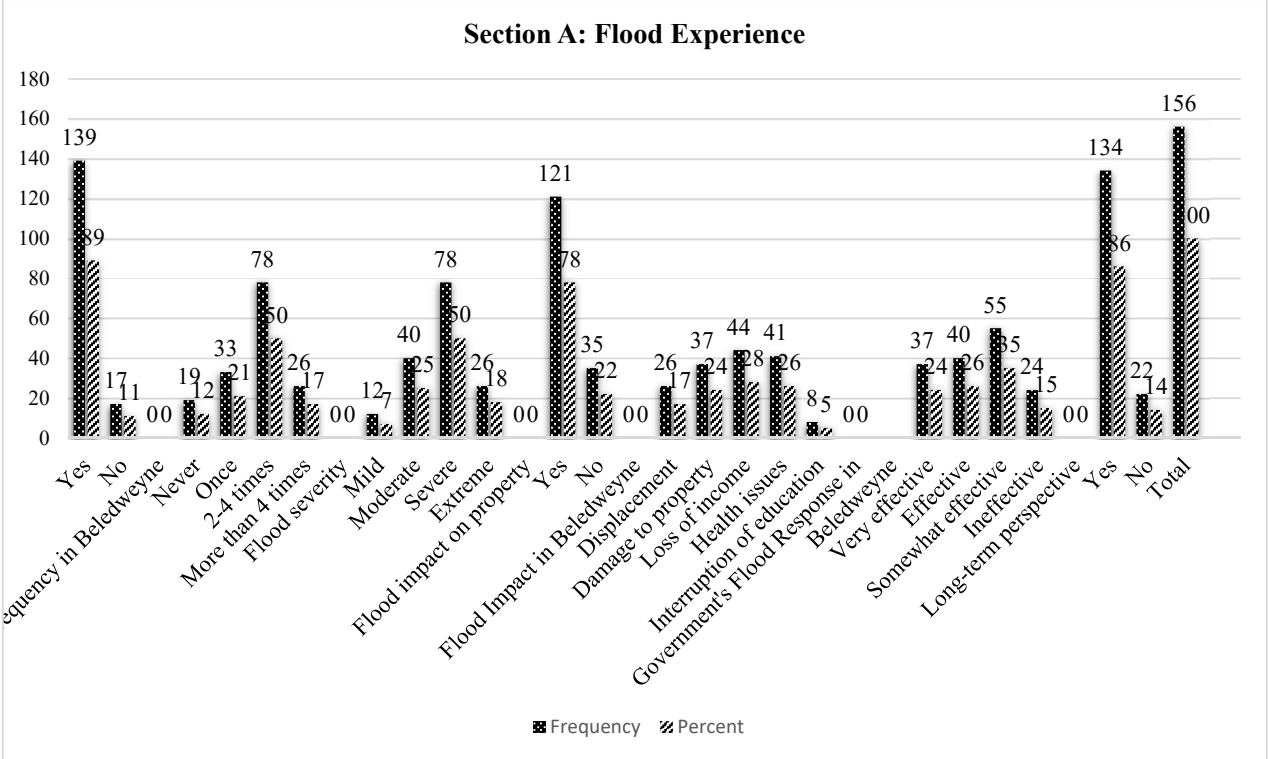

Figure 2: Flood Experience of Respondent

The flooding in Beledweyne, Somalia primarily happens during the rainy seasons, of which Somalia experiences two rainy and two dry seasons. As reported by the Federal Republic of Somalia (FROS) in 2013, rainfall patterns in Somalia are typically characterized by low and irregular occurrences. The nation's average annual rainfall is estimated to be around 250 mm. In the northern maritime plains, the climate is notably hot and arid, receiving an average annual rainfall of less than 250 mm. Conversely, the southern and southwestern regions of the country receive approximately 400 mm and 700 mm of rainfall respectively. In the central semi-arid areas, rainfall levels are considerably lower, ranging from 50 to 100 mm per year. [20]

The data in figure 2 indicates that a substantial majority, corresponding to 89% of the participants have been personally affected by floods, highlighting the extensive ramifications experienced in the community. This distribution implies a significant direct knowledge of the consequences of floods among most respondents. Further examination of the data delineates that half of the participants, or 50%, have experienced flooding events between two to four times, whereas a lesser segment of 12% have never been exposed to floods personally, often attributing their lack of exposure to physical absence from the city during such events, although their families and possessions were nonetheless affected. Collectively, the table substantiates that the prevalence of flood encounters among the respondents is high.

Moreover, the data encapsulates the prevalent perception among participants of the severity of flooding, with 50% describing the floods as highly severe. A further breakdown shows that 25% rated the severity as moderate, Together, these observations reflect a profound perception of flood severity, particularly in Beledweyne. An alarming 78% of participants reported property damage due to floods. These statistics accentuate the largely detrimental effects of floods on individuals and their properties, intensifying socioeconomic challenges within the affected community.

The collected data reveals that floods have prompted a range of adverse outcomes within the community. Specifically, it reflects that 28% of respondents have experienced a diminution in income, 26% have encountered health complications. These repercussions illustrate the broad spectrum of flood-induced challenges, with the most significant being the impact on income. Within the context of northern Ghana, the analysis shows that the devastation of crops by floods substantially increases the risk of malnutrition. This escalation in nutritional risk is

due to restricted access to vital foodstuffs, whether these are distributed as humanitarian assistance, acquired from remote marketplaces, or received from families in regions unaffected by flooding. The dependency of northern Ghana's residents on natural resources means that floods impact them in distinctive ways, influencing their potential migratory decisions away from the area. [10]

The data shows a general approval of the participants considering the government's flood response to be positive: 35% find it somewhat effective. After Pakistan's 1973 devastating floods, the Federal Flood Commission was formed in 1977, focusing on flood control in the Indus River Basin and operating under the Ministry of Water and Power. The FFC's key roles include developing flood control policies, approving management plans, evaluating damage, and improving flood forecasting and alert systems. [1]

In Figure, 2. The data indicates that, from a long-term perspective, 86% of respondents affirm the lasting socioeconomic consequences of floods in their community. To this research, effective communication strategies and visual aids like flood maps are crucial for raising awareness. Involving private companies, as seen in the UK's partnership funding scheme, enhances flood-risk management. A synergistic approach combining top-down, and bottom-up policies is vital for resilient flood control. [11]

Floods represent a secondary determinant of food insecurity, following droughts, yet their pervasive occurrence renders them the predominant cause of food insecurity in Somalia. [22]

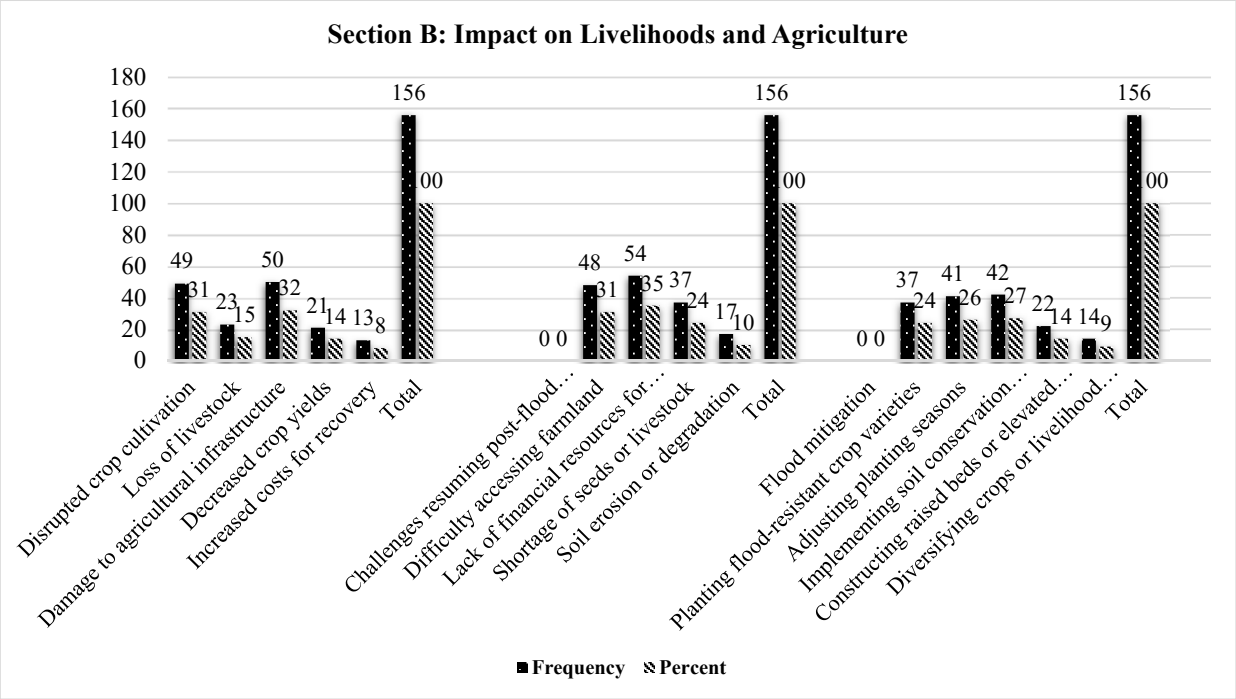

Figure 3: Impact of Floods on Livelihoods and Agriculture

Figure 3 illustrates the significant effects of flooding on agricultural livelihoods and incomes, as indicated by damage reports from the Beledweyne community. Agricultural infrastructure was compromised for 32% of participants, while crop cultivation disruptions were identified by 31%. Passive evidence from Zhenhua [12], indicates that, in the latter half of the 20th century, China experienced more intense flood-related disasters in terms of frequency and affected areas, with the decade's ten most severe years for such events recorded. Flood-related damages, primarily through crop inundation, have led to failed harvests, hindered growth, and diminished crop coverage and productivity, severely compromising productivity, livestock, and rural inhabitants' quality of life.

Insights into the difficulties faced by individuals in resuming agricultural operations post-flood are offered by the data. Financial resource scarcity during recovery was the most common challenge, reported by 35% of respondents, demonstrating substantial economic barriers to agricultural restoration. Access to farmland posed a challenge for nearly one-third 31% of the participants. In northern Ghana, similar to this study seed destruction from floods as a specific post-flood agricultural issue, with relatives and friends offering vital support to farmers hindered by flood-related seed losses. Social networks emerge as crucial tools for mitigating flood risks. [10] Nigeria, historically, attention has been more on responding to floods than controlling them. Presently, the reduction and mitigation of vulnerability to flood risks are prioritized by the Nigerian government's disaster risk management strategy. The national framework's objective is now to transition from reactive flood response and recovery towards proactive management of risks [13].

By the end of this section, it is noted that individuals have adopted certain agricultural practices to lessen flood impacts

on their livelihoods. Soil conservation is employed by 27% as a measure against flood effects, while 26% have altered planting periods. According to the research conducted in Cameroon in 2018, adaptability is recognized as a key survival strategy, with farmers in the north modifying their practices to mitigate climate shock impacts on agriculture [14].

In this study conducted in Somalia, researchers emphasized the necessity of combining a hazard map, which included variables such as elevation, slope, drainage density, distance to rivers, annual rainfall, geology, and soil type, with a vulnerability map to implement a multi-criteria analysis approach for mapping flood-prone areas. Factors such as population density, land use/land cover, distance to road networks, GMIS, and HBASE were also considered in this analytical framework. The resulting map indicated that 17.82% of the studied region faces a high to very high risk of flooding, while 23.64% exhibits a moderate risk, and 58.52% presents a low to very low risk. This mapping outcome can serve as a valuable reference for decision-makers in Somalia, aiding in the identification of potential preventive measures, improved land use planning, and more effective flood risk management strategies amidst the challenges posed by climate change [19].

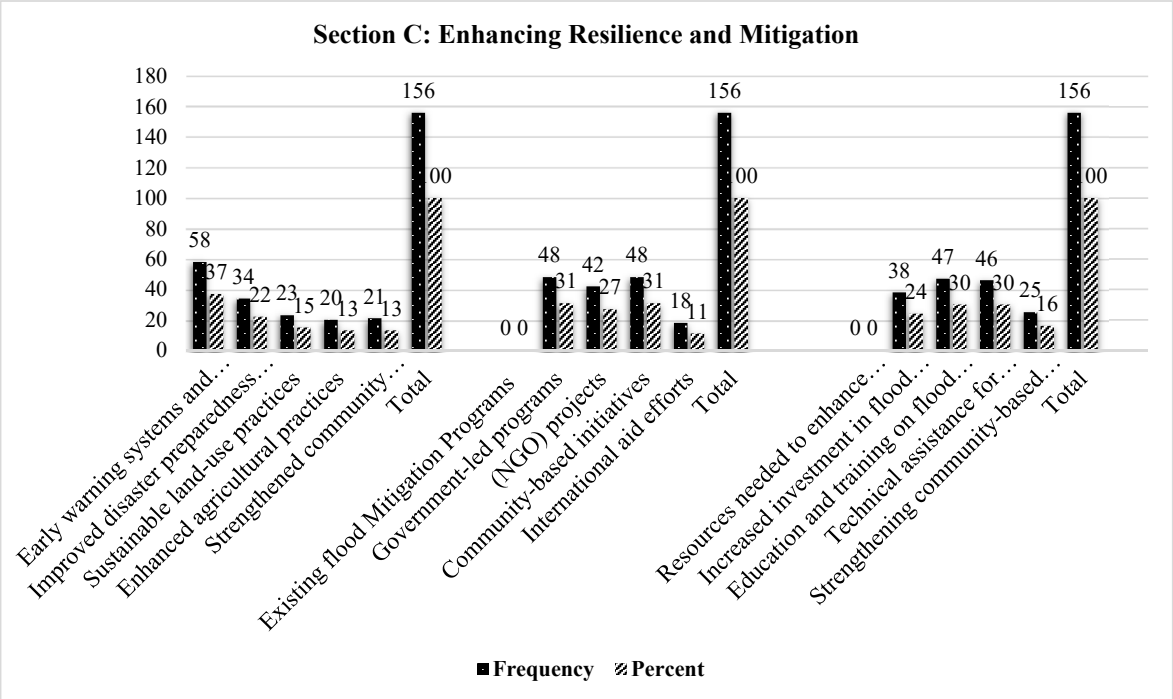

Figure 4: Enhancing Resilience and Mitigation to Floods

Figure 4 reveals respondent perspectives on strengthening community resilience against future flooding, indicating that 37% consider early warning systems and community alerts of high importance. As the studies noted, the primary goal of the Flood Forecasting and Warning System (FFWS) is to alert the public and other stakeholders of impending flooding promptly and efficiently [15].

The data assesses whether Beledweyne possesses mitigation and resilience initiatives against floods, showing that 31% of respondents recognized government programs aiming towards these goals. Another 31% pointed out community-based efforts, indicating local engagement. This illustrates a multifaceted approach involving government, NGOs, community actions, and international support to reduce flood vulnerability and build resilience in Beledweyne. In Cameroon, major deficiencies in flood management are attributed to the Department of Civil Protection, with a notable shortcoming being the inadequate integration of disaster risk reduction in legislation and a lack of inter-institutional coordination [14].

To enhance flood resilience in the community. The majority, at 30%, stressed the importance of education and training on flood preparedness, alongside an equal percentage advocating for technical assistance in sustainable agriculture. Additionally, nearly a quarter of respondents 24% identified the need for increased investment in flood infrastructure. Similarly, within the Makako community, the study reveals that the majority of employment activities are centered around fishing, resulting in residents being rendered more vulnerable to the aftermath of flooding. This vulnerability is compounded by factors such as low education and training levels, which are shown to impact flood preparedness, along with a general lack of planning for flood risks [5].

The scope of technological solutions for flood monitoring and alert systems extends beyond the method proposed in Somalia. Researchers globally are investigating the utilization of technology to create intelligent flood monitoring systems capable of offering instantaneous data on water levels, precipitation, and other environmental variables influencing floods [16]. Radar sensors such as Sentinel, along with

optical sensors like Landsat and the Moderate Resolution Imaging Spectroradiometer (MODIS), in addition to land surface hydrologic routing models, have the capability to assess the magnitude of a flood. [17] As demonstrated by the research conducted by Abdukadir et al., the IoT-based flood detection system designed for river floods in Somalia underwent successful testing and validation. Deployed at Beledweyne and Afgooye, areas prone to river floods, the system effectively identified flood occurrences and promptly distributed alerts to local authorities and communities via diverse communication channels like SMS and web applications. This developed IoT-based flood detection system holds promise for substantially enhancing flood management and response efforts in Somalia. By aiding in minimizing the environmental and human impacts of floods, it has the potential to bolster the resilience of local communities against future flood events [18].

		Agricultural productivity	Socioeconomic factors	Flood mitigation strategies	Community resilience
Agricultural productivity	Pearson Correlation	1	.652**	.959**	.932**
	Sig. (2-tailed)		.000	.000	.000
	N	156	156	156	156
Socioeconomic factors	Pearson Correlation	.652**	1	.671**	.712**
	Sig. (2-tailed)	.000		.000	.000
	N	156	156	156	156
Flood mitigation strategies	Pearson Correlation	.959**	.671**	1	.932**
	Sig. (2-tailed)	.000	.000		.000
	N	156	156	156	156
Community resilience	Pearson Correlation	.932**	.712**	.932**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	156	156	156	156
**. Correlation is significant at the 0.01 level (2-tailed).					

Table 2. Analyses of Correlation Co-efficient

Pearson Bivariate correlation coefficient was used to compute the correlation between the Dependent variable (Socioeconomic factors) and the independent variable (Agricultural Productivity, Flood Mitigation Strategies, and Community Resilience). The presented table encapsulates a comprehensive analysis of the correlation relationships among key variables Agricultural productivity, Socioeconomic factors, Flood mitigation strategies, and Community resilience.

The robust positive correlations observed between Agricultural productivity and both Socioeconomic factors (0.652**) and Flood Mitigation strategies (0.959**) affirm the multifaceted nature of agricultural systems. The positive correlation with Socioeconomic factors underscores the intricate linkages between economic development and agricultural output. Similarly, the positive correlations between Socioeconomic factors and Flood Mitigation strategies (0.671**) and Community resilience (0.712**) illuminate the role of socioeconomic development in enhancing community resilience. The exceptionally strong correlation between Flood Mitigation strategies and Community resilience (0.932**) underscores the critical role of strategic planning and infrastructure development in fostering resilient communities. This correlation implies that communities that invest in robust flood mitigation strategies are more likely to exhibit higher levels of resilience.

Finally, this research contributes significantly to the discourse on sustainable agricultural development, socioeconomic resilience, and disaster mitigation. The correlations observed among the variables underscore the need for holistic and integrated approaches in policy formulation and community development, emphasizing the interconnectedness of agricultural, socioeconomic, and resilience dimensions.

4. Conclusion

The findings of the study have shed light on the profound impact of floods in Beledweyne and the comprehensive awareness among the surveyed participants regarding these natural disasters. Despite the acknowledgment of effective government approaches to floods, there is a noteworthy recognition of enduring impacts, emphasizing the urgency of addressing and mitigating the consequences of floods in the community. The multifaceted and substantial effects of flooding on various aspects of agricultural activities have been highlighted, revealing a diverse range of challenges individuals face post-flood. In recognizing these challenges and proactive efforts, respondents advocate for increased investment in flood infrastructure, education and training

on flood preparedness, technical assistance for sustainable agriculture, and the strengthening of community-based organizations. In conclusion, the findings of this study not only deepen our understanding of the complex dynamics of floods in Beledweyne but also provide a foundation for informed and targeted interventions to enhance the community's resilience in the face of future flood events.

Recommendations

Considering the study's results, the researcher proposes the following recommendations, requiring the engagement of diverse stakeholders, to mitigate the socioeconomic effects of floods on the region:

- Advocating for increased investment in resilient infrastructure to minimize flood severity and safeguard essential community assets.
- Implementing widespread education and awareness programs to enhance community understanding of floods, including early warning systems and evacuation procedures.
- Strengthening local community organizations, empowering them to play a more active role in disaster response, recovery, and long-term resilience-building efforts.
- Enhancing the effectiveness of government-led programs addressing flood resilience through regular evaluation and adjustment based on community feedback.
- Investing in research and innovation to develop new technologies and strategies for flood resilience, spanning infrastructure, agriculture, and early warning systems.

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