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## Research Article

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# **Analysing drivers of community vulnerability to flood hazards in Kasese Municipality, Uganda**

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**Abstract:** Floods have become common characteristics of climate change in recent years. In the Western part of Uganda, Kasese Municipality, at least five major flash flood disasters have been experienced since 2013 and have left a trail of devastation and human deaths in their wake. Because communities' survival is at stake, it's critical to understand how disaster vulnerability is built. Many vulnerability drivers, on the other hand, are frequently hidden and distant from the triggering events. With the projected increase in extreme flooding due to climate change, the research study focused on analysing the drivers of community vulnerability to flood hazards in Kasese municipality. To analyse the drivers of vulnerability, key informants and focus group discussion were used. The major drivers of vulnerability to flood hazards in Kasese Municipality were high levels of poverty, lack of adequate land for settlement and farming, lack of adequate information on disaster risk management, and lack of early warning system. However, none of these factors, by themselves, make the community vulnerable. Instead, they are mutually inclusive, with each supporting the other(s). The findings of the study can help the government and decision-makers strengthen policy actions by strengthening flood disaster risk reduction mitigation measures and guaranteeing optimal resource use to reduce future vulnerabilities and consequences.

**Keywords:** Climate change, Drivers, Floods, Natural Hazards, Vulnerability

## 1 Introduction

Floods have become common characteristics of climate change in recent years, and they have affected different communities in which they are experienced. However, the severity of the impacts of extreme and non-extreme weather and climatic events depends strongly on the level of vulnerability of a system (Field *et al.*, 2012). Vulnerability is defined as the potential for a loss (Cutter, 1996; Mitchell, *et al.*, 1989), or the propensity or predisposition to be adversely affected and it encompasses sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2018). Flood vulnerability itself refers to the exposure, susceptibility, and ceaselessness of people or any region to flood hazard and the inability to cope up with its impacts (Rehman *et al.*, 2019). Flood vulnerability depends on the number and value of elements at risk and their susceptibility (Messner and Meyer, 2005). A system or an area is more vulnerable to flooding the more elements at risk it contains and the more valuable, the more susceptible and the more exposed those elements at risk are (Scheuer *et al.*, 2011). A disaster results from the combination of exposure to a hazard, socio-ecological vulnerability that are present, and the limited capacities of households or communities to reduce or cope with the potential negative impacts of the hazard.

Reducing vulnerability by enhancing adaptive capacity increases community resilience. Communities or societies with high vulnerability are usually less resilient while high resilience typically implies less vulnerability (Fritzsche *et al.*, 2014). For example, the lack of safe water and lack of hygienic toilets supplies, low health budget and staff levels, shortage of hospital beds and health consultations, as well as low level of maternal and child care) were among the major adaptive capacity factors that increased health vulnerability to flooding (Maini *et al.*, 2017). It is also important to note that the poorest are often more vulnerable to disasters and climate change impacts than better-off households (Béné *et al.*, 2012). Keeping this in view, natural hazards remain a considerable challenge to poverty reduction and development in many countries around the world (Zou and Wei, 2010). For example, during the period 1998 to 2017, flood disasters were responsible for 11% of the loss of life and 23% of the economic loss caused globally (Santos *et al.*, 2020). Natural hazard impact is often associated with vulnerability. Therefore, understanding the causes of vulnerability is important for reducing these disasters.

This is because it helps in identifying potential entry points for policy intervention (Zou and Wei, 2010).

The pressure and release (PAR) model emphasize the underlying driving factors of vulnerability and the conditions existent in a system that contribute to disaster situations when a hazard occurs (Ciurean *et al.*, 2013). These factors can be categorized into economic, demographic, and political processes. A study in Southeast Asia identified ineffective communication between different stakeholders relating to all phases of the disaster risk reduction cycle as one of the main factors contributing to vulnerability (Zou and Wei, 2010). Further, employment and age were also relevant drivers of individual vulnerability (Santos *et al.*, 2020). In the United Kingdom, precipitation, temperature, intra-urban asset deterioration, buildings and contents, social impacts and weakening of the river morphology and sediment supply, rural land management, and environmental regulation were the major drivers of future urban flood risk (O'Donnell and Thorne, 2020). Therefore, reviewed literature shows different drivers of vulnerability to floods in different local populations. The causes of vulnerability to floods vary from one community to another. Age, gender, poverty and settlement in floodplains also affected the vulnerability of communities and individuals to floods (Mucherera and Mavhura, 2020). Bearing in mind the aforementioned literature, with the increasing trend in rainfall (Tibara *et al.*, 2021a) and increasing frequency and magnitude of flash floods in the area (Jacobs *et al.*, 2020; KDLG, 2020; Tibara *et al.*, 2021b) with consequent damages, this research focused on analysing the drives of community vulnerability to flood hazards in Kasese Municipality. The findings of the study can help policymakers and community planners devise ways for addressing the drivers to reduce vulnerabilities to floods in Kasese and make communities more resilient.

## **2 Methodology**

### **2.1 The study area.**

The research was carried out in Kasese municipality, which is part of the Kasese district, Western part of Uganda. The municipality covers a land area of 93.4 square kilometers and lies on Latitude: 0° 28' south, Longitude: 30° 35' East, and an average altitude of 1,441 meters. The Municipality is divided into three divisions i.e., Bulembia, Nyamwamba and Central divisions

(Figure 1). These divisions are in a hazard-prone location where flash flood disasters have wreaked havoc on households. (IFRC, 2013). The municipality has experienced at least five major flash floods since 2013 creating a path of destruction and burying people's homes, land, and livelihoods. Leaving many households displaced and dire need of food, shelter, and safety. Kasese district lies between latitudes  $0^{\circ}12'S - 0^{\circ}26'N$ ; longitudes  $29^{\circ}42'E - 30^{\circ}18'E$  and is bordered by the districts of Bundibugyo in the North, Kabarole in the North East, Kamwenge in the South East, Rubirizi in the South and the Democratic Republic of Congo in the West (KDLG, 2016).

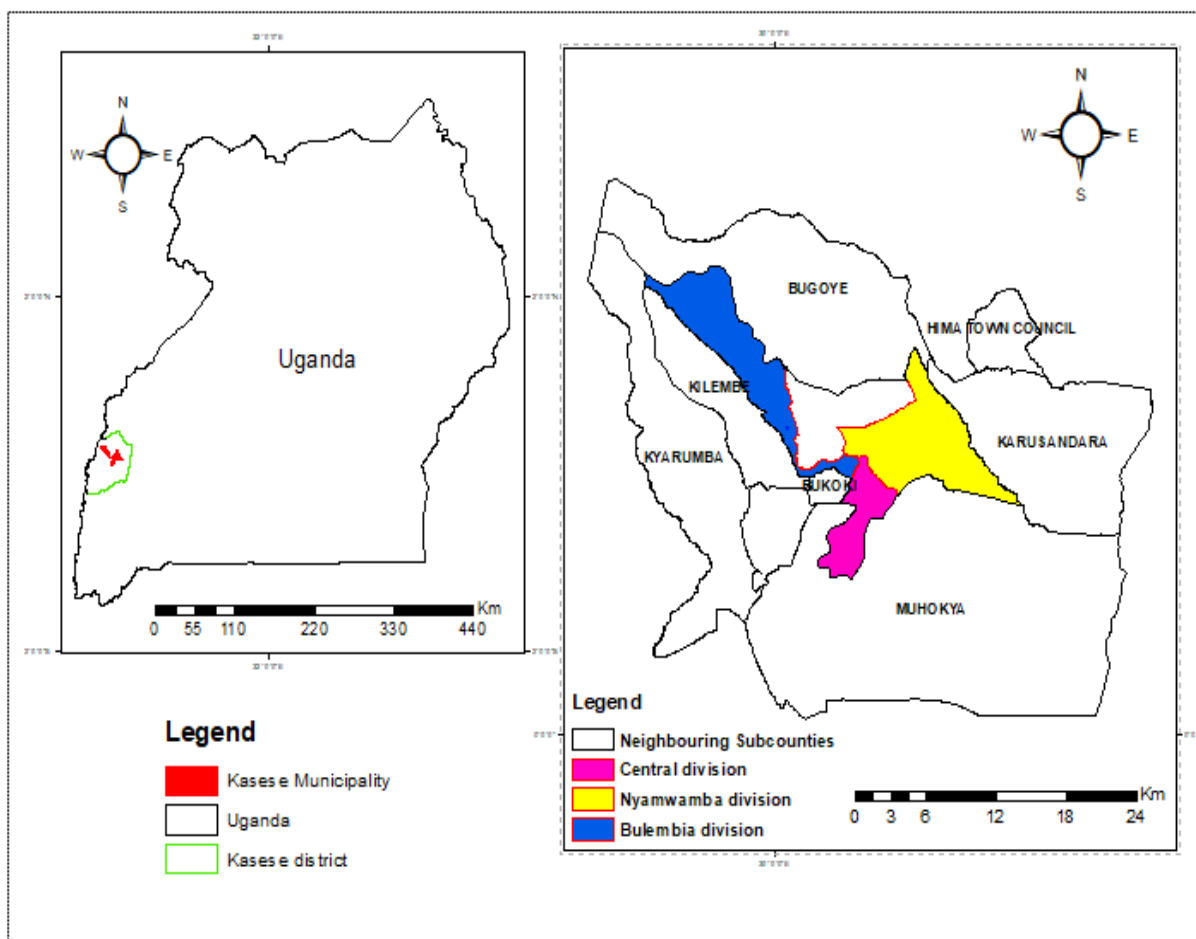


Figure 1: Map showing the study area

Kasese district experiences a bimodal rainfall pattern. The first rains are short but fall with high intensity and occur during the March-May season, and the long rains from August-November with low intensity. Annual rainfall ranges from 800mm to 1600mm and is greatly influenced by altitude. The temperature in the Nyamwamba catchment in which Kasese municipality is

located varies with elevation, ranging from 0 to 25°C at high elevations and from 8 to 30°C at low elevations (DWRM, 2012).

According to the 2014 national population and housing census, the population of Kasese district was 694,987 persons which were 2.01% of the total national population. Of this population, females were 359,592 (51.7%) while males were 335,400 (48.3%). The population growth rate was estimated at 2.45% per annum; well over that of the country's rate of 3.4% per annum (UBoS, 2017). The district has a youthful population (population below 18years) of about 55.5% with an average household size of 5.3 persons. According to the 2014 Kasese district local government profile, Bulembia, Nyamwamba, and Central divisions had 13,251, 56,103, and 31,711 households respectively. Kasese district plays a significant role in the economy of the country with several activities taking place such as tourism, agriculture, trade, and mining (Katutu *et al.*, 2019). The major (65%) economic activity in the district is subsistence farming (Mirembe *et al.*, 2019).

## **2.2 Methods**

The drivers of vulnerability to floods were identified through a qualitative research method. The research tools used included key informant interviews and focus group discussion. Key informants were considered because they had a wider range of first-hand knowledge about the community important for the research. Focus group discussion provided an insight into different opinions about the subject under study and provided a consensus on the drivers of vulnerability. The key informants involved nine purposively selected informants to identify the drivers of vulnerability to floods in Kasese Municipality. To allow the key informants to react in their own words, open-ended questions were used. Meaningful, rich, and explanatory responses were elicited as a result. Informants and discussants who had quality information on the topic under discussion and leadership roles in the community were selected. Each interview lasted for at least 30 minutes. Thereafter, to avoid bias, a focus group discussion (FGD) that had at least three representatives from each division was conducted to further identify and rank the different drivers of vulnerability to floods. The FGD involved local cell chairpersons (3), members from the municipal disaster risk management committee (3), church leader (1), elderly (2), youth (2), a representative from the non-governmental organization (1), and previously affected persons

(3) by floods from each division. These were assumed to have wider knowledge and experience to identify and assess the key drivers of vulnerability to floods in the areas of study.

Key informants were used to identify the different drivers of vulnerability in the area. The focus group further analysed the drivers identified by the key informants in addition to what they suggested during the discussion. The potential impact of each driver was then given a rank from insignificant to very high impact for vulnerability to floods by the focus group.

Before the key informant interviews began, each informant was informed of the objective of the study. Informants were briefed on the confidential nature of the study and were assured that the information collected will be only used for research purposes. The informants had a right to decide whether to participate and could withdraw at any stage of the interview process.

### 3 Results and discussion

From the key informants and focus group discussion conducted, several drivers of vulnerability to floods were identified (Table 1). The assigned impact presents the significance of each driver to flood vulnerability in Kasese municipality.

Table 1: Drivers of vulnerability to floods

S/n	Driver	Assigned impact
1.	High level of poverty	Very high
2.	Low levels of education	Moderate
3.	Age of the household head	High
4.	Lack of knowledge and information on disaster risk management	High
5.	Lack of early warning system	Very high
6.	Lack of adequate land for settlement and farming	Very high
7.	Increased frequency of rainfall due to climate change	High
8.	The effects of other disasters such as wildfires and landslides	Moderate
9.	Increasing population	High

In recent years the adverse impacts of climate change on the natural environment and the multiple threats it poses to the human environment, especially in the Global South, have become increasingly evident and these are likely to increase in the near future, with more people likely to be at risk. For instance, in the last decade, at least three major flood disasters have ravaged Kasese municipality (IFRC, 2013; KDLG, 2020) and left a trail of destruction. Although disasters result from the interactions of hazards and vulnerability conditions, the drivers of vulnerability to floods vary from one community to another (Mucherera and Mavhura, 2020).

According to the key informants and the focus group discussion, one of the major drivers of vulnerability to floods was high levels of poverty. Key informants explained that poverty associated with lack of resources and low-income levels had influenced people to live and work in areas exposed to potential hazards, while they had less or no resources to cope with when a flood disaster strikes. They further explained that, due to the high levels of poverty in the community, people were not even in a position to access better health services, and enough food to support their families. They said people are found in poor houses which they were renting with poor building materials and did not have the finances to even protect those houses from floods which pre-exposes them to flood damages. Poverty was ranked a very high impact driver and therefore contributed significantly to household vulnerability to floods in this community. This is consistent with studies that revealed, that poor populations are less resilient to stress and disasters due to a lack of capacity and resources to cope with and recover from disasters (Mahanta and Das, 2017; Oluoko-Odingo, 2011). There is a consensus in the literature that low-income households suffer greater losses from floods than households with high income (De Silva and Kawasaki, 2018; Dube *et al.*, 2018; Mucherera and Mavhura, 2020).

Low levels of education were another driver of vulnerability to flood hazards in Kasese municipality, however, it was ranked moderate. Key informants indicated, that highly educated households and household heads were better aware of the flood risk. They mentioned that educated household heads have better fair knowledge and have access to information that influences their decisions towards mitigation, preparedness, and response to flood hazards. They claimed educated household heads were found in less flood risk areas and can capably involve flood-proof designs and other measures in their buildings. They were also in a position



to save due to a greater livelihood strategy. This is consistent with a study in which it was found that better education in the population had clear short-term effects on reducing vulnerability through awareness about crucial information, faster and more efficient responses to alerts, and better post-disaster recuperation (Pichler and Striessnig, 2013). Education enhances individual resilience in dealing with disaster risks (Shah *et al.*, 2019). Similarly, in Nepal, education significantly lowered the number of household deaths due to floods (Samir, 2013). This is further supported by a review by (Muttarak and Lutz, 2014) in which highly educated individuals and societies were reported to have better preparedness and response to the disasters, suffered lower negative impacts, and were able to recover faster.

Age of the household head. Key informants indicated the age of the household heads also affected household vulnerability to floods. They pointed out that, the elderly especially women above 70 years were more vulnerable to floods compared to the youth since they were unable to work and support themselves. The elderly people were unable to get adequate food and access to decent shelter for themselves. The focus group indicated the youth were more vibrant compared to the elderly and were in a better position to earn compared to the elderly who were largely depending on support from other people. A similar observation was made by Lee and Vink (2015) in which aged people especially those above seventy years were found more vulnerable to flood risk. The young and the elderly people are vulnerable to natural hazards both because of their physical condition and their financial dependence (Müller *et al.*, 2011). However, a study by Chombo *et al.* (2018) in Kyoga plains in Uganda found that vulnerability levels to climate change impacts varied across the age groups which is contrary to this finding. Therefore, this shows there is no consensus on the effect of age on vulnerability to climate change.

Lack of knowledge and information on disaster risk management. There is a growing need for accurate and reliable information concerning flood risk and other natural hazards as an aid to political and economic decision-making. Key informants indicated that the lack of information especially on mitigation, preparedness, response, and recovery before, during and aftermath of flood disasters is critical and hampers efforts towards flood risk management. They mentioned that the government has not done enough to train, educate and sensitize people on how to

manage flood risk despite the increased frequency of flood disasters in their area. People were still found building structures and planting crops in flood plains, especially the poor, and thus in event of a flood disaster, many households are affected. Before communities can deliberately anticipate floods they must become aware of the possibility of a flood (awareness) and take measures to protect themselves (preparedness) (Schelfaut *et al.*, 2011). Low level of awareness among the public, policy makers, decision makers, and other stakeholders in understanding the impacts of extreme events and possible measures to reduce the impacts of those extreme events significantly affects the efforts toward flood disaster risk management (Barredo *et al.*, 2007) and thus higher vulnerability of flood-prone communities. The more knowledge and information available on flood risk management, the lower the vulnerability (Müller *et al.*, 2011). In Pakistan, the lack of knowledge and information was among the main constraints in the adoption of certain adaptation measures to deal with climate variability (Fahad and Wang, 2018). This driver was ranked as highly significant in Kasese municipality, implying it highly influences the level of household vulnerability to floods in these areas.

Lack of adequate land for settlement and farming. Key informants explained that limited access to land especially for farming and settlement was a critical driver of vulnerability to flood hazards in their community. They indicated that the population of the municipality has been rapidly increasing since 2008. According to UBOS (2017), the municipality had 25,497 households with an average household size of 5.3 persons and is projected to increase to 31,743 households by 2024 with its associated negative impacts on land management. The low land acreage per capita has led to fragmentation of land leading to low marginal productivity on-farm per household. They explained that people have been settling and farming in flood plains near the Nyamwamba river and other rivers, where they are highly exposed to river and flash flooding due to the increased urbanisation. They said, a bigger percentage of people were also still found in rented and semi-permanent houses. For instance, only 37.2% of the households in Kasese municipality were residing in their own houses and 28.9% were living in semi-permanent houses (UBOS, 2017). This situation affects their decisions to protect their houses. This is because households living in their own house are more inclined to adopt and take protective measures compared to households living in rented or leased houses (Kita, 2017). Previous flash floods have displaced people and destroyed agricultural farmlands and thus

affecting people's livelihoods. The 2013 Kasese floods saw 25,445 people forced from their homes (MWE, 2015). During the focus group discussion, all the focus group members agreed that this was a major driver and was ranked very high. This finding corroborates the findings of other studies (Jaquet *et al.*, 2016; Mucherera and Mavhura, 2020).

**Lack of early warning system.** An early warning system (EWS) helps to reduce economic losses and mitigate the number of injuries or deaths from a disaster, by providing information that allows individuals and communities to protect their lives and property. An early warning system empowers people to take action before a disaster (Tarchiani *et al.*, 2020). In Kasese municipality, the key informants indicated that there was no early warning system in place, and the focus group indicated this was a very high factor or driver of vulnerability of the households to flood hazards. They indicated that the continued lack of an early warning system in place to timely alert communities and people significantly affects households' capacity to reduce damages to movable properties in case of an imminent danger especially floods. They attributed the continuous loss of properties during the flood disasters to the lack of early warning to people by the government since the floods come abruptly and do not allow people to take their properties to safer places. This collaborates with a study (Rai *et al.*, 2020) in which improving a flood EWS by increasing lead time helped to minimize the avoidable loss and damage from floods. However, a poor early flood warning system is a key obstacle in mitigating households to floods and therefore, the need for access to quality weather forecasting and early warning system (Shah *et al.*, 2018).

**The effects of other disasters such as wildfires and landslides.** Nyamwamba sub-catchment in which Kasese municipality is situated does not only experience flash floods but also forest fires and landslides among others (Jacobs *et al.*, 2017; Katutu *et al.*, 2019). According to the key informants, the compounding effects of these other disasters affect the vulnerability of households to flood hazards. They explained that these other disasters affect peoples' livelihoods such as the destruction of agricultural farms, electricity power lines, and water sources among others, and therefore, in case of a flood disaster, they find people already vulnerable which compounds damages. For instance, between 2017 and 2018, landslides and drought affected 275 and 33 plantations respectively which were sources of livelihood for

people (Katutu *et al.*, 2019). The effects of other disasters such as drought and landslides lead to severe impacts on households and livelihoods and therefore limited time to bounce back when impacts occur within the shortest period within the same area.

Among other drivers of vulnerability to floods included increased population and increased frequency of rainfall due to climate change. The informants explained that the size of families has been increasing. According to UBOS (2017), the average household size in the Kasese district was 5.3 persons and is expected to increase. A large family might experience more competition over limited available resources, or they might have fewer savings to meet emergency needs during or after a disaster (Shah *et al.*, 2019) and thus increased vulnerability. The Larger the household size, the larger the number of people exposed to flood disasters in a community.

Vulnerability to flooding is propelled by a bundle of drivers as discussed above that made the households and communities succumb to flood impacts. None of those drivers, however, make the community vulnerable on its own. Rather, they are mutually inclusive, with each one reinforcing the other(s). Vulnerability to flooding in Kasese Municipality is thus not solely a function of changes in the poverty levels among others to which communities respond, rather, it is a result of multiple interdependent drivers which affect the households' level of exposure, sensitivity, and capacity to cope with floods.

#### **4 Conclusions**

The study has analysed the drivers of vulnerability to flood hazards. It has emerged that vulnerability to flooding is majorly driven by the high levels of poverty, lack of adequate land for settlement and farming, lack of knowledge and information on disaster risk management, lack of early warning system, increased frequency of rainfall due to climate change and the effects of other disasters such as wildfires and landslides. However, these drivers affect households' vulnerability to floods differently and are mutually inclusive, with each supporting the other(s). To lessen the high levels of vulnerability in the community, the local government with support from the central government, and other stakeholders should put more effort into installing the early warning system, ensure active participation of the local communities, raise

public awareness, and educate and disseminate right information about flood disaster risk management. Despite the importance of national and regional climate change adaptation plans, policymakers should design area-specific policies and address climate change at the lower levels based on their characteristics. The research indicates the need for government and other development partners to continuously engage stakeholders at lower levels such as villages/ cells to get information important for policy actions to reduce the level of hazard vulnerability.

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