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Flood Vulnerability Assessment in Kilembe, Uganda

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Abstract

On a global basis, there is evidence that the number of people affected by floods are on the rise. This research study assessed the level of community exposure, sensitivity and resilience and the households' risks perceptions to floods in Kilembe. The research design for this study involved an index-based approach. The primary data was obtained using a semi-structured questionnaire, 194 households were purposefully selected. The study revealed that the community was highly exposed to floods. About 43.3% of the households were found living less than two kilometres from the flooding river. The households were also found highly susceptible to flood hazards with 78.9% of the households had a monthly average income of about US$52. However, the community had high capacities to cope with the effects of flood hazards. Only 17.0% of the households surveyed had gone to the local authority for assistance in the last 1 year. About 98.5% of the households thought that the frequency of occurrence and impacts of flooding had increased during the last decade, and 74.4% of the households felt very worried about the floods. The government should install early warning system, ensure active participation of the local communities, and timely and adequately respond to floods.

Keywords: Flood hazard • Flood vulnerability • Resilience • Exposure • Uganda

Introduction

The world is witnessing a rapidly increasing impact of disasters which constantly threatens peoples' lives and livelihoods [1-3] and, therefore, a great concern to man. Globally, in terms of occurrences, climate-related disasters have dominated. Between 1998 and 2017, global climate-related disasters (including floods) accounted for 91% of all 7,255 recorded events [2]. Within the same period, disasters accounted for direct economic losses valued at US$ 2,908 billion, of which climate-related disasters caused 77% of the total direct economic losses [2].

In Uganda extreme weather and climate events such as floods and droughts are also common. Previous years in Uganda have seen erratic arrivals and endings of rainfall seasons, and individual rainfalls have been heavier and more violent . In Uganda, floods are seasonal and usually occur in periods of intense rainfall and el-Niño phenomena. Floods may increase the spread of malaria especially during and after the flood event, and hence compounding the community vulnerability to health hazards [5]. Floods cause physical damage by washing away structures, destroying farmlands, submerging human settlements, displacing people and causing loss of lives [3]. For instance, in 1997, floods affected 153,500 people, killing 100 in Uganda, and in 2007 it also affected 718,045 people. In Uganda, internal displacement of persons over the periods between 1998 and 2008 due to hazards including flooding was about 1,800,000 people [3-5] further indicated that over the past 50 years, at least seven major flash floods have affected catchments of the Rwenzori Mountains including Kilembe. The Rwenzori mountains are not only subject to flash floods, but also to forest fires, earthquakes and landslides [6]. One of the most devastating events occurred on 1st May, 2013 in the Nyamwamba catchment in which Kilembe is situated [6]. The International Federation of Red Cross and Red Crescent, [4] reported that this flash flood happened after heavy rains that lasted for over six hours causing the River Nyamwamba to burst its banks and flooded several areas including Kilembe [4]. Eight people were confirmed dead, and several households affected [4]. The flood caused widespread destruction of houses, crops and facilities such as bridges, roads and power lines. Major infrastructures such as hospitals and sewage treatment unit were also damaged [4]. Similarly on 7th May, 2020, Kilembe experienced another devastating flood event that left a trail of destruction [5]. Floods are also expected to increase in frequency and severity triggered by climate change Environment [4]. The increased exposure of floods to these communities increases community's vulnerabilities to disasters and changes the community's lifestyles and hence affecting their capacities to respond [5-6].

Managing floods with the aim of safety and wellbeing of people and their environment can be done through vulnerability reduction and increasing resilience [7]. Communities must identify exposure to hazard impacts to proactively address emergency response, disaster recovery, and hazard mitigation, and incorporate sustainable development practices into comprehensive planning [8]. Adelekan (2011) adds that the sources of vulnerability are also associated with societies' patterns of development, and small investments in reducing risk can have disproportionately large positive impacts in protecting communities from harm. Social developments such as risk perception is also considered a crucial aspect in the context of flood risk management [9]. Regions with low levels of flood risk perception and low degree of preparedness for coping with flood events tend to experience flood damage levels above average [10]. The paper assessed the community vulnerability and perceptions to floods which provided site-sensitive information to decision-makers and communities towards disaster risk management. The Government of Uganda has a target to increase the capacity to cope with the increasing impacts of climate change such as frequent floods in a bid to reduce the level of vulnerability envisaged in the Uganda vision 2040 [11].

Profile of the study area

The study was undertaken in Kilembe subcounty, Kasese district, Western region of Uganda. Kilembe lies approximately along latitude 0012'17''N and longitude 3000'59''E. Kilembe neighbours greater Bugoye subcounty in the East, Kyonde subcounty in the West and Mahango and Kyarumba subcounties in the south (Figure 1). Kasese district is one of the rural districts of Uganda with its headquarters located approximately 360 kilometres west of Kampala the Capital City of Uganda [12]. Kasese district experiences a bimodal rainfall pattern. The first rains are short but fall with high intensity and occur during March-May season, and the longer rains from August-November with a low intensity. Annual rainfall ranges from 800mm to 1600mm, and is greatly influenced by altitude [13]. The soils in the district are organic, ferrosols, podsols/eutrophic, and hydromorphic. The dominant soil type is clay-loams and contains high reserve of weatherable minerals on alluvial deposits [12]. Kasese district is comprised of principally three topographical features, namely

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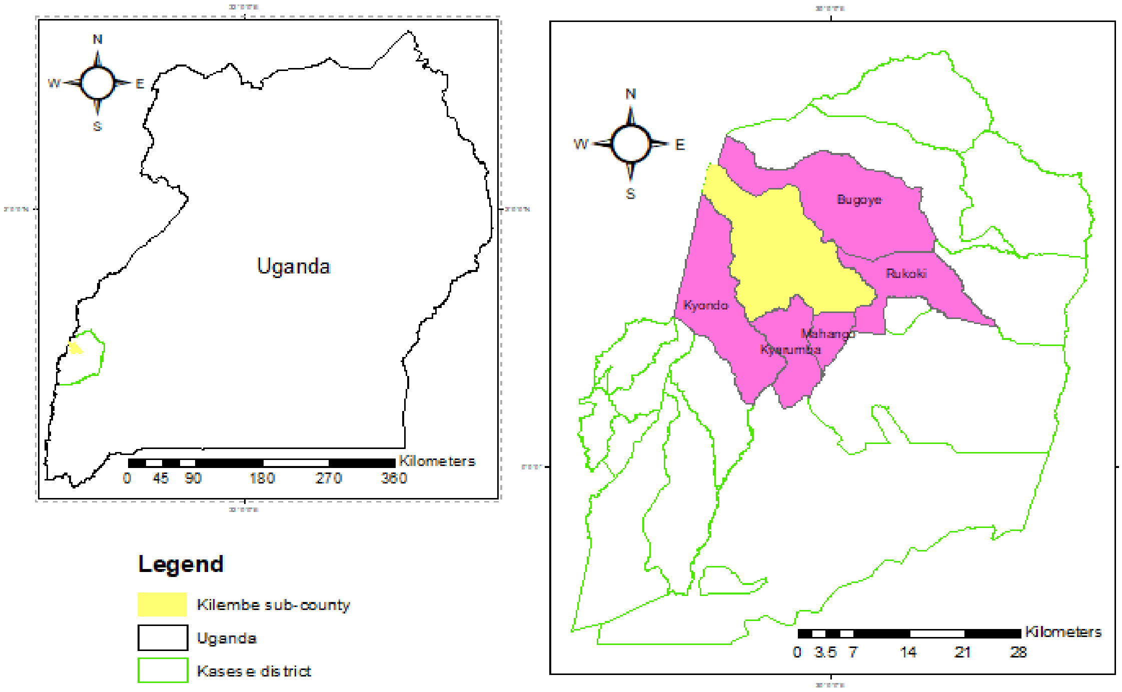

Figure 1. Location of Kilembe Sub-county Source: Prepared by the author.

the mountainous areas, which consist of rugged mountain relief, the undulating region at the foothills, and the lowland flat areas in the South and South-Eastern part of the district [12].

Methodology

The research design for this study involved a cross sectional survey. An index-based approach was employed to assess the level of community exposure, sensitivity and resilience to flood hazards in Kilembe Sub-county. The study also assessed the perception of households to floods. Primary data was obtained using a semi-structured questionnaire, key informant interviews and physical observations on the selected indicators, and perceptions of households to floods. Households within the same geographical area are always equally exposed to a stressor, but the levels of sensitivity vary from one household to another [14]. People have different ideas and notions about environmental quality and their perception of a spectrum of environmental problems needs to be assessed [15]. To get acquainted with the study area, a reconnaissance was first undertaken. A reconnaissance was initially done with a view of establishing the main climate risks that are common in the area and the livelihood issues that could constitute the indicators selected under exposure, sensitivity and resilience. This was to validate the indicators that had been identified from the literature (Figure 1).

To establish the flood vulnerability level, flood vulnerability index (FVI) was used where E means Exposure, (S) Susceptibility, and (R) Resilience [16]. The indicators of exposure and susceptibility are multiplied and then divided by the resilience indicators, because indicators representing exposure and susceptibility increase flood vulnerability and are, therefore placed in the numerator. The resilience indicators decrease flood vulnerability and are thus part of the denominator [17].

Further, to be able to use this expression of flood vulnerability index, firstly, operational indicators for exposure, sensitivity and capacity/resilience were identified. This was followed by data collection, allocation of weights to different classes of phenomenon under each indicator, computation of exposure, sensitivity and capacity/resilience index of flood-prone areas, and lastly, interpretation of results (Table 1).

The indicators for the study (Table 2, Table 3 and Table 4) were selected widely through literature review [18,19] and were selected based on their suitability and usefulness. They were then customised to Kilembe during the pretesting of the questionnaire and validated by the key informants. The variables or indicators were further divided into classes depending on their individual characteristics into two or more different classes (for instance, nature of response: yes or no), three classes, four classes and five classes. These classes were formulated to illustrate the degree of variation possible in that variable. Weights were assigned to each class within an indicator, based on vulnerability level following standard normalisation procedures [20]. In most of the cases, highest vulnerable classes were assigned with the weight value 1, while the least vulnerable 0. In situation of yes and no response, the weights varied between 0 and 1. For indicators with three levels of phenomena, the weights were assigned as 0.33, 0.67 and 1. Similarly for four classes of phenomena, the weights were 0.25, 0.50, 0.75 and 1, and for five classes of phenomena, the weights were 0.2, 0.4, 0.6, 0.8 and 1.

After proper weights allocation to classes of phenomenon for each indicator, the index for each component was calculated, i.e., the composite index for exposure, sensitivity and resilience were computed independently from:

$$CI = \frac{(W_1 + W_2 + W_3 + \cdots + W_n)}{n} = \sum_{i=1}^{n} \frac{W_i}{n}$$

Where CI is the composite index, W1 to Wn are respective weights assigned to indicators, and n is the number of indicators used for computing the composite index.

Vulnerability index was then computed from the formula provided by [15,16,18].

$$FVI = \frac{EI * SI}{RI}$$

The indices obtained were also compared with the values <0.01, 0.01-0.25, 0.25-0.50, 0.50-0.75 and 0.75-1 for very small vulnerability to floods, small vulnerability to floods, vulnerable to floods, high vulnerability to floods and very high vulnerability to floods respectively [21].

To obtain information on the household's perception to flood risk, data were collected through the administration of a purposely designed questionnaire. The data included socio-economic characteristics of the respondent, households' past flood experience and concern and perception of flood risk in their area of residence. The questionnaire data (inclusive of the perception to floods) were coded directly into IBM Statistical Package for Social Sciences (SPSS) version 20 after data cleaning and analysed using quantitative methods involving descriptive statistics.

Sample Size

According to the Uganda National Population and Housing Census 2014, Kilembe subcounty had 13,632 households. The representative sample size for the study was obtained using sample size determination method;

Table 1. Socio-economic characteristics of the respondent.

Socio-economic characteristics	Frequency	Percentage (%)
Sex		
Male	111	57.2
Female	83	42.8
Age		
18-29	68	35.1
30- 39	70	36.1
40-49	32	16.5
50-59	23	11.8
>60	1	0.5
Marital status		
Single	64	33
Married	102	52.6
Separated/Divorced	17	8.8
Widowed	11	5.6
Education qualification		
No formal Education	59	30.5
Primary Education	40	20.6
Secondary Education	66	34
Tertiary Education	29	14.9
Occupation		
Civil servant	15	7.7
Private/ professional	23	11.9
Trader	35	18
Farming	115	59.3
Others	6	3.1

Table 2. Selected indicators and weights allocated under exposure.

S/n	Indicator	Class	Frequency	Percentage frequency	Weights allocated to classes
1	Type of house	Brick walls with iron/tiles sheet roof	152	78.4	0.33
		Mud walls with iron/tiles sheet roof	37	19.1	0.67
		Mud walls with thatched roof	5	2.5	1
2	Distance of house from the river	Less than 1km	7	3.6	1
		Between 1 and 2km	84	43.3	0.67
		More than 2km	103	53.1	0.33
3	Households with injury/ death in previous floods	Yes	52	26.8	1
		No	142	73.2	0
4	Type of family	Joint/ extended family	24	12.4	0.33
		Nuclear	129	66.5	0.67
	Size of household	Single	41	21.1	1
		Less than 5 persons	84	43.3	0.33
5		Between 5 and 10	86	44.3	0.67
		Greater than 10	24	12.4	1

Table 3. Selected indicators and weights allocated under sensitivity.

S/n.	Indicator	Class	Frequency	Percentage frequency	Weights allocated to classes
1	Households with means of transportation	Yes	42	21.6	0
		No	152	78.4	1
2	Households with a mobile telephone	Yes	155	79.9	0
		No	39	20.1	1
3	Households with a television or radio	Yes	113	58.2	0
		No	81	41.8	1
4	Households with access to electricity	Yes	38	19.6	0
		No	156	80.4	1
5	Households with access to improved sanitation	Yes	55	28.4	0
		No	139	71.6	1
6	Households with access to clean/ safe water	Yes	82	42.3	0
		No	112	57.7	1

7	Distance to the nearest health facility (kilometres)	Less than 1km	51	26.3	0.25
		Between 1 and 5km	85	43.8	0.5
		between 5 and 10km	50	25.8	0.75
		More than 10km	8	4.1	1
8	Households who have borrowed money for flood related matter in the last 10 years	Yes	46	23.7	1
		No	148	76.3	0
9	Household's main occupation	Civil servant	16	8.2	0.25
		Private/Professional	16	8.2	0.5
		Trader	15	7.7	0.75
		Farmer	147	75.8	1
10	Household's monthly average 9 income (In Uganda shillings, Ugx)	50,000-190,000	153	78.5	1
		200,000-340,000	32	16.5	0.75
		350,000-490,000	7	3.6	0.5
		>500,000	2	1	0.25
11	Households living in community (years)	<8	60	30.9	1
		16-Aug	64	33	0.8
		16-24	33	17	0.6
		24-32	21	10.8	0.4
		>32	16	8.2	0.2
12	Households with family 11 members having chronic illness/ disability (Number)	0	3	1.5	0
		1	141	72.7	0.33
		2	36	18.6	0.67
		>2	14	7.2	1
13	Dependence ratio	0	96	49.5	0
		0.08-0.31	37	19.1	0.25
		0.31-0.54	31	16	0.5
		0.54-0.77	26	13.4	0.75
		0.77-1.00	4	2.1	1

Table 4. Selected indicators and weights allocated under resilience.

S/n.	Indicator	Class	Frequency	Percentage frequency	Weights allocated to classes
1	Households that had gone to any local authority for any assistance in the last 1 year	Yes	33	17	0
		No	161	83	1
2	Household's relationship with the community	Poor	7	3.6	0.33
		Moderate	66	34	0.67
		Good	121	62.4	1
3	Households with relatives employed outside the community	Yes	132	68	1
		No	62	32	0
4	Households with relatives outside the community	Yes	165	85.1	1
		No	29	14.9	0
5	Households having at least land or house in the community	Yes	113	58.2	1
		No	81	41.8	0
6	Households with any form of saving	Yes	133	68.6	1
		No	61	31.4	0
7	Households with family members earning (in number)	>2	7	3.6	1
		2	40	20.6	0.67
		1	121	62.4	0.33
		0	26	13.4	0
8	Households' number of sources of income	>2	1	0.5	1
		2	28	14.4	0.67
		1	143	73.7	0.33
		0	22	11.3	0
9	Households with family members having training and a first aid kit	Yes	22	11.3	1
		No	172	88.7	0
10	Households with previous experience with floods	Yes	102	52.6	1
		No	92	47.4	0
11	Highest level of education of the household head	No formal education	62	32	0.25
		Primary education	35	18	0.5
		Secondary education	66	34	0.75
		Tertiary education	31	16	1

$$\text{Sample size (SS)} = \frac{Z^2(P)(1-P)}{e^2}$$

where Z is confidence level (± 1.96 at 95%), p is percentage picking choice expressed as decimal (0.5 is used for sample size needed), and e is the precision value (0.07 = ± 7). Therefore, 194 households were obtained from the sampling method. The May 2013 flood disaster event affected 441 households in Kilembe [22]. The 194 households sampled was an equivalent of 44% of affected households and 1.4% of the total households in Kilembe subcounty.

Kilembe subcounty has four parishes. Two parishes that had at least experienced floods in the last decade were selected. Two villages were purposefully selected from each parish. From each parish, 97 households were selected using a systematic random sampling procedure. The study targeted the heads of the households as respondents. The household survey was conducted between 21st June and 2nd July, 2020. The survey was conducted from Monday to Sunday between 8am and 6:30 pm by two trained local field assistants in order to capture information from households that work during week days. Respondents' consents were sought and obtained to participate in the interview and were assured of the confidentiality of responses.

Results and Discussion

Socio-economic characteristics of the respondents

From the household survey conducted, out of the 194 household respondents interviewed, majority (57.2%) was the male gender, 36.1% were between the age of 30-39 years, and 52.6% of the households were married (Table 1). Farming was the most (59.3%) engaged activity of the households. About 30.5% of the respondents had no formal education and only 14.9% had tertiary education.

Community exposure to floods

Once a potential hazard is identified, the risk emerges due to the presence of exposed elements i.e., presence of susceptible elements or physical features of human society (infrastructure) and economic systems (livelihoods) which can be affected by the potential hazard. To assess the community's exposure to floods, five (5) indicators were selected and weights allocated to individual classes under these indicators (Table 2).

Majority (78.4%) of the households had houses with at least brick walls/ iron-sheet roofs (Table 2). This means that the houses within the area were largely the same and this is also supported by a survey by [23] in which they found that 93.9% of the households in Kasese live in dwelling units constructed using permanent roof materials such as iron sheets. Brick walls with iron/tiles sheet roof were allocated a lower weight value (0.33) because houses of those materials were assumed to reduce vulnerability. They are assumed to be strong compared to mud walls with thatched roof and, therefore, reduced exposure. Majority (53.1%) of the houses were found in more than two kilometres (km) from river Nyamwamba and therefore, a weight of 0.33 was allocated to houses located beyond 2km from the river because of the less exposure associated with them. Majority of the households (65.5%) were nuclear and only 21.1% were single families. Single families were allocated a higher weight of one than extended families which were allocated a weight of 0.33. This was because single family type was assumed to be more isolated and thus had limited access to community resources and support. Households with persons between 5 and 10 were the majority (44.3%) followed by households with less than five persons (43.3%). The weights allocated to these classes were in such a way that, households with less than five persons had a lower weight (0.33) because the smaller the household size the smaller the number of people exposed [24]. This is consistent with a study by [25] in which households in Kumi district, Uganda experienced weather shocks such as floods because of larger household sizes.

A composite exposure index of 0.5549 for the households in Kilembe was obtained and this means the community is highly exposed to flood hazards [21]. Therefore, with a projected increase in heavy precipitation events [14] the frequency of rainfall triggered flash floods is likely to increase and hence further increasing the exposure of these households. However, forest fires, earthquakes and landslides occur as well in the area [6] which further increases exposure to other disasters. On asking households on how they feel about floods, about 74.7% of the households were very worried of the floods in their communities. Households further continued to live in the highly exposed area because most of the households claimed to have no alternative land to settle in. However, a Chi-square test did not show any significant relationship ($\chi 2$ =10.803, p=0.289) between household heads and feeling about floods. This is contrary to a study by [26]. in which they revealed that, females were more vulnerable than males due to limited mobility and physical strength.

Household sensitivity to floods

Sensitivity is the degree to which a community is being affected by stress [26] such as floods and to assess this, 12 indicators were selected and individual weights allocated under their different classes (Table 3). Survey results showed that, 78.4% of the households had no means of transportation and the weights allocated to households was 1 since households with no access to transportation were assumed to be at more risk. Most (79.9%) of the households had mobile phones which was important for receiving and sending information in case of a flood event. Similarly, majority (58.2%) of the households had a radio, however, 80.4% had no access to electricity. This finding corroborates with findings of [23]. Majority (57.7%) of the households also had no access to clean and safe water, and yet, most of the households (43.8%) were in a distance between one and five kilometres from a medical/ health facility.

Lowest weight of 0.25 was allocated to households who were within less than one kilometre from the nearest health facility because the longer the distance from the health facility, the higher will be the level of vulnerability [5] revealed that, floods increase the spread of malaria especially during and after the flood event, and hence compounding community vulnerability to health hazards. On occupation, most of the households (75.8%) were farmers and majority (60.3%) of the households had their agricultural farms destroyed by the previous floods.

When asked on the households' levels of income, average monthly income was low with majority (78.9%) of the households had an income between Uganda shillings, Ugx 50,000 and 190,000 (1USD=3650 Ugx) and with this coupled with the most households (50.5%) having a high dependence ratio between 0.50 and 1.00, it made households highly susceptible to flood risks. This should be the reason why all households surveyed claimed to have not taken any measure to protect their houses against floods. This is very critical as [27] reported that the intensity and frequency of floods significantly impact the economy and the welfare of Ugandans, especially the poor and vulnerable. Households with low income levels hardly meet their daily expenditures and thus affects their capacity to prepare and recover from the effects of flood disasters [28]. About ten million people representing 21.4% of the Uganda population by 2017 still lived below the poverty line [23] and thus having reduced consumption levels and in case of a flood event, they may not timely cope and recover from the effects of floods. This is evidenced by majority (73.2%) of the households from the survey found to had taken at least 12 months to recover from the effects of the 2013 flood event. Similarly, most (30.9%) of the households had lived in the community for less than eight years and only 8.2% had stayed in the community for more than 32 years. Households who had lived in the area for less than eight years were assigned a higher weight of one since they were assumed to be less experienced with the area and assumed to know evacuation routes.

With majority of households found with no means of transport, no access to electricity, low household income levels among others (Table 3), Kilembe was found highly susceptible to flood hazards with a composite sensitivity index of 0.5924. Further, the area was found not having any flood early warning system.

Community resilience to flood risk

Resilience has been raised as a core task within disaster risk reduction frameworks [28] and, therefore, promoting household resilience to climate extremes is a key development priority [30]. Resilience is associated with the capacity of individuals, social groups or households to accommodate stresses and disturbances, to self-organize, and to learn to maintain or improve essential basic structures and ways of functioning. In assessing this, eleven (11) indicators were selected and weights allocated to each class (Table 4). From the survey, majority (83.7%) of the households had not gone to their local authority for some assistance in the last one year and only 16.3% had gone to their local authority for food and non-food items. The weights allocated to households who had not gone to their local authority for assistance was one because they were described as households who did not need government assistance and, therefore, assumed to cope with floods by themselves and thus a higher weight.

Around 62.4% of the households described their relationship with the community as good. Majority (85.1%) of the households had relatives outside the Kilembe community and 68.7% had relatives employed outside the community. However, majority (62.4%) of the households had only one family member earning. Most (32.0%) of the household heads had no formal education, and most (73.7%) of these households had only one source of income. There was a significant effect between the number of household's head income sources and the households with savings ($\chi 2 = 47.478$, $p<0.05$). Meaning households with at least two incomes sources were also in position to save.

This collaborates with a study by [31] in which household's access to stock food and savings increased with the increased income level. In describing households experience with floods, 52.6% had previous experience with floods and thus were assumed more aware of issues and problems with floods [32] and hence high capacity to cope with floods. However, the composite resilience index for the households was 0.5856, meaning that Kilembe sub-county had high capacities to cope with and adapt to the impacts of flood hazard.

Household vulnerability to flood hazards

Vulnerability is a function of exposure, sensitivity and resilience/capacity [26]. With a higher exposure index value of 0.5549 and sensitivity of 0.5924, and resilience value of 0.5856, the overall flood vulnerability index (FVI) value obtained was 0.5613. On comparing it with the flood vulnerability indices designated from Balica et al. [24], Kilembe was found highly vulnerable implying that there is a high potential for loss of lives and high economic losses to flood disasters. This is critical as Uganda continues registering and struggling with the impacts of climate change which threatens the possibility of achieving the sustainable development goal 13 on combating climate change and its impacts [33]. Increased flood risk increases household vulnerability [27]. There was also a significant effect between the period households had lived in the community and feeling vulnerable to flood hazards ($\chi 2 = 6.571$, p-value = 0.028, alpha value = 0.05).

However, all households surveyed claimed they were never consulted in any activity related to flood disaster risk management in their locality. There was no active committee on flood risk management. In order to reduce vulnerability to flood hazards, households recommended that the flooding river(s) should be dredged, resettle the most exposed households to safer places, plant trees along the flooding river channels, sensitize communities on flood risk management, construct and repair the damaged public infrastructures, build gabions along the river channel, install early warning system and adequately and timely respond to flood disasters in the area.

Community risk perception to floods

Risk perception is currently considered a crucial aspect in the context of flood risk management (Lechowska, 2018). This is because improving public flood risk perception is conducive to the implementation of effective flood risk management and disaster reduction policies [34]. From the survey, 98.5% of the households thought that the frequency of occurrence and impacts of flooding had increased during the last decade, while 89.2% also thought that the magnitude of the floods had increased (Table 5). This must be linked to the recent flood disasters that have been experienced in the area i.e. 2013, 2014, 2015 and 7th May, 2020 [13].

On asking households on the future likelihood of flood occurrence and prevention, majority (99.9%) of the respondents thought that a flood like that of 2020 can occur again, however, 85.5% thought that these floods can be prevented. Majority (92.3%) of the households felt unsafe in the area they lived because of floods, 74.4% of the households felt very worried about the floods, while 95.4% felt that they were vulnerable to these floods (Figure 2) which is consistent with the high vulnerability level obtained. This is in line with the report by [12] in which they reported that the continuous exposure of communities to disasters including floods might increase community's vulnerabilities to disasters. Higher feeling of vulnerability among households could mean that such households would readily embrace an intervention directed at reducing their risk, given that other factors are taken care of [35]. However, the effect of the highest level of education for household's head and feeling vulnerable to floods in the community was found not significant ($\chi 2 = 1.645$, p-value =0.161, alpha value of 0.05).

When households were asked about the level of government response towards flood disasters, 99% reported that government was responsible for managing floods, and majority (40.2%) of households described government's involvement as moderate, however, most (56.7%) accepted to have received assistance from government towards flood response and these included food and non-food items, and shelter through camps (Figure 3). According to key informants, the government and other partners provided food and non-food items in the aftermath of floods. Further, most (91.2%) of the respondents claimed that government response was always late and 96.4% described the government's response inadequate. That explains why a very small percentage (0.5%) of the households thought that government was doing enough in managing the flood risk, while a majority (95%) thought that government was not doing enough in managing the flood risk. Similarly, all households claimed that government was fully responsible for managing flood risk in their areas. Yet, the government of Uganda is still spending the bulk of its resources on managing and responding to disaster as opposed to managing and reducing disaster risk [36].

Conclusions and Policy Recommendations

The concept of vulnerability to flood hazard is an integral part of integrated flood risk assessment and management. The study revealed that, the households in the area were generally highly exposed and susceptible to flood hazards. Therefore, with a projected increase in heavy precipitation events, the frequency of rainfall-triggered flash floods is likely to increase and hence increasing further the exposure of these households. Households were largely of low-income level and had high dependence ratio and took long period to recover from the effects of previous flood events. However, households had generally high resilience or capacities to resist, absorb and cope with the effects of flood hazards. Overall, households were found highly vulnerable to flood hazards. The households' perceptions to flood hazards were also found generally low and this may hinder them from pursuing precautionary and mitigation measures against and appreciate government responses towards flood disaster risk management.

Table 5. Perception on the frequency and severity of floods.

Description	Response	Percentage (%)
Do you think the frequency of occurrence and impacts of flooding have increased during the last decade?	Yes	98.5
	No	1.5
How can you describe the 2020 flood magnitude compared to previous flood events?	Less	2
	Medium	8.8
	Higher	89.2

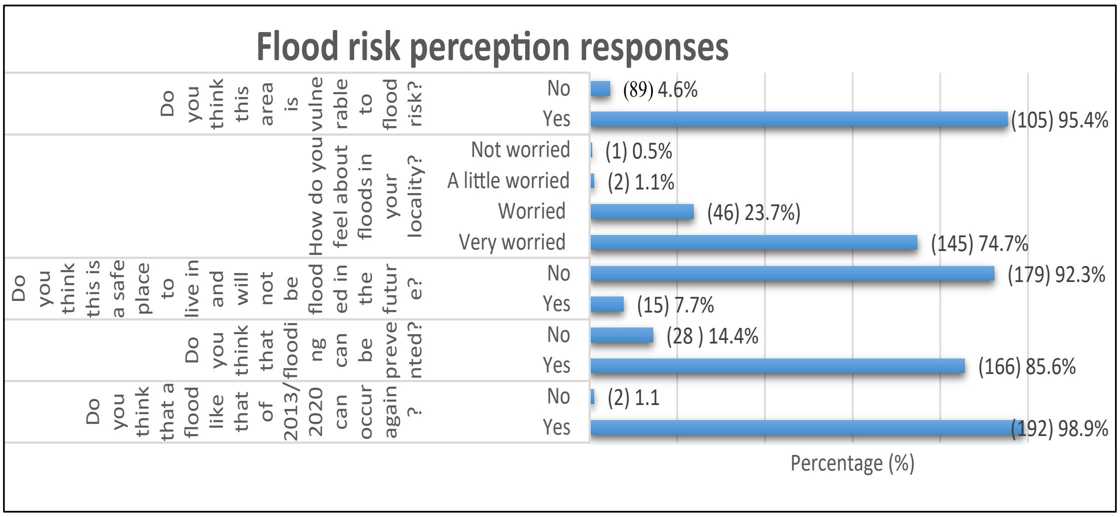

Figure 2. Flood risk perception responses.

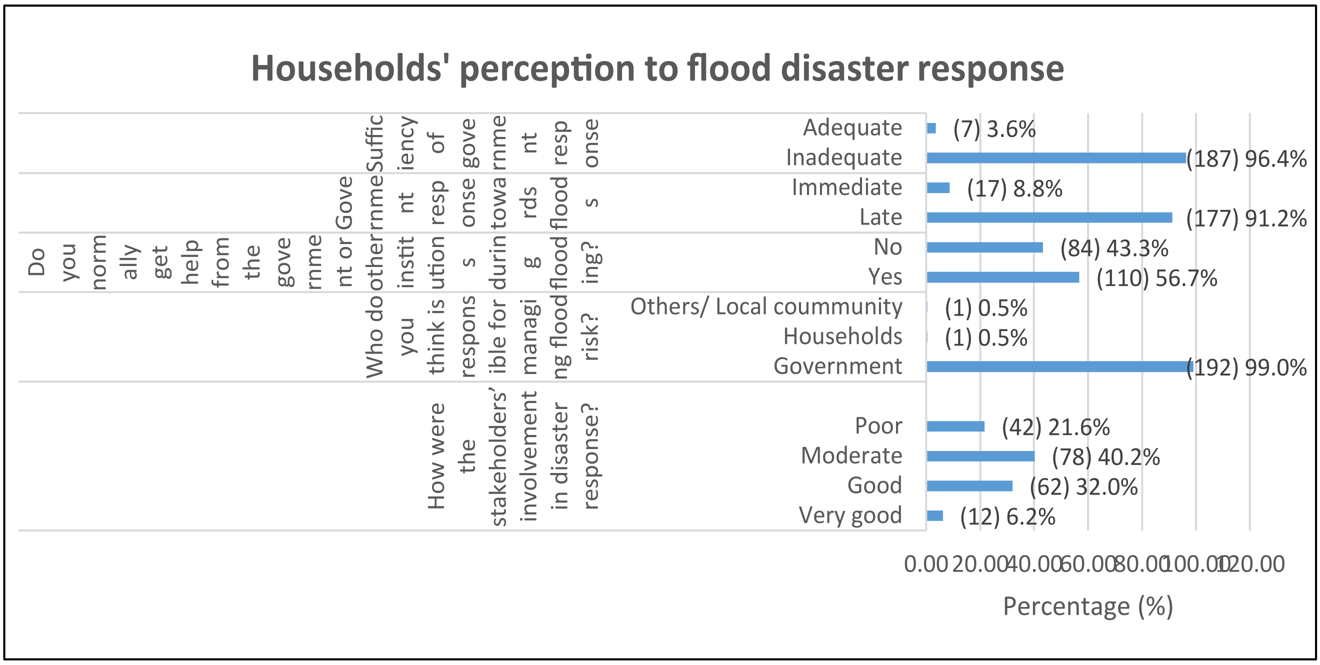

Figure 3. Households' perception to flood hazards.

Residents indicated that, the area may be unhabitable in the future if no actions are taken by government towards flood disaster risk management. To reduce the community's vulnerability, the local government with support from central government should put more efforts in installing the flood early warning system, ensure active participation of the local communities, raise public awareness and educate and disseminate right information about flood disaster risk management. Further, the household capacity level can be increased by providing employment and livelihood diversification opportunities to improve the household income and savings. The households should also take voluntary precautionary measures to protect their houses and other properties from floods since the local government alone cannot effectively protect flood prone communities in the view of limited resources. The local government should timely and adequately respond to flood affected communities in order to save lives, ensure public safety and meet the basic subsistence needs of the people affected.

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