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Assessment of the Local Strategies Used in Abating Flash Floods for Improvement of Community Livelihoods in Nyamwamba and Bulembia Divisions, Kasese District, Uganda

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Authors' contributions

This work was carried out in collaboration between both authors. Author OM formulated the study objectives, conducted the literature search, designed the methodology, collected and analyzed the data. Author AB formulated the title and objectives of the study, conducted the literature search, analyzed the data, discussed the findings, and proofread the entire manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Floods are intricate events that cause a range of human exposures, including loss of lives, property, and damage to infrastructure of the communities. Flash floods though often blamed on inappropriate development planning and climate variability, floods can be predicted to a reasonable extent, whose scale and nature are often less certain. The study aims at assessing the local strategies used in abating flash floods for improvement of community livelihoods. Specifically, the study explored the challenges the local communities faced during the implementation of the strategies, and also determined the relationship that emanated as a result of implementing the local strategies and community livelihoods. The study adopted a descriptive cross-sectional survey design, collecting both quantitative and qualitative data from 218 respondents and 08 Key Informants that held key responsibilities at the Municipal Council and the community. Information from the respondents and Key Informants were collected using questionnaires which was in form of interviews and face to face interviews respectively. The study shows that some local strategies have been implemented towards controlling flash floods such as, restoration of river banks (69.3%) planting bamboo trees along river banks (66%), use of gabions (65.6%), putting check dams (65.6%) and construction of manmade channels (95.9%) along the hillsides. Putting flood barriers (73%) that floods affect the community livelihoods in various aspects of daily life and the local economy in terms damage of crops (74.8%) risk of diseases (83 %) loss of livestock (60 %), displacement (93%); The challenges faced in implementation of the of local strategies in the study area include financial constraints (81.2%), technical and logistical issues (63%), poor infrastructural design (83.9%), and environmental challenges (66%). A Chi square test showed that the implemented local strategies were significantly related to the community livelihood at P=0.001. Implemented local flood strategies resulted to a positive relationship to the agricultural productivity and protected community property at P<0.05. Overall, effective flood management strategies are able to reduce risks and contribute to a better community health with fewer disruptions to community's daily life at P<0.05. Local communities should adopt and implement the use of the mentioned local strategies like re-channeling of water pathways along the hill sides and use of gabions for flash floods mitigation since they cost effective. There should be a country-wide implementation of community-initiated mitigation measures for abating flash floods and related climate change disruptions aimed at building and promoting community resilience and livelihoods of people living in flood prone areas.

Keywords: Community livelihoods; flash flood risks; floods mitigation strategies; Kasese District; Uganda.

1. INTRODUCTION

Floods are considered as hazards that cause risks to human life as well as impacting on community livelihood. Floods are intricate events that cause a range of human exposures, including loss of life, property, and damage to infrastructure of the communities [1]. Flash floods though blamed on inappropriate development planning and climate variability, floods can be predicted to a reasonable extent, with the exception of flash floods, whose scale and nature are often less certain [2]. Apparently the most important issue is now how to reduce these flood risks using the local strategies for long-term flood control focused on improving community livelihood [2]. This may be achieved together with the commitment of the international community that focuses on disaster risk reduction and disaster resilience as a key framework for sustainable development and poverty eradication [3]. Flash floods are not regarded as a single event but something that cause suffering to the communities on a continuous scale which may be multiple and has simultaneous effects on people's lives and the community as whole [2]. Therefore, while hazards like the flash floods continue to ravage the lives of many people, there is a need to build capacity to deal with such impacts and this heavily depends on the capacity and the resources that the communities may apply [4]. It is important to note that, communities are integral in driving information upwards and downwards, between the local and national levels of society, to develop skills and capabilities that help people become more resilient to such unfavorable conditions [2].

Kamal et al. [5] indicated that world over flash floods is among the deadliest catastrophes and

that they result into one-third of all deaths, one-third of injuries and one-third all damages from natural disasters. Flash floods in the arid regions are a double-edged natural wonder being simultaneously blessing and a curse. They represent natural phenomenon that results from large amounts of heavy rainfall during a short time especially in mountainous areas. Floods occur often along mountain streams where much of the ground is covered by impervious rocks. Flash floods across all regions of the world are becoming more frequent, intense and unpredictable and leave grave impact on local communities [6]. Researchers have stressed alternative ways of flash flood control strategies to adapt to future flood hazards. For example, in United Kingdom (UK), Stefanidis and Stathis [7] states that both natural and anthropogenic flash floods are a menace to the livelihoods of people that end by claiming lives. According to Koks et al. [8], floods risk is reduced depending on the capacity of community to adapt and respond to flash floods. In addition, the authors suggest that flash flood risk management needs to be tailored to a local condition, considering the socio-economic characteristics of homes and neighborhoods within a prone area. According to Kousky [9], he argues that due to high poverty levels, people have become more vulnerable because they live in hazardous areas including flood plains and steep hills. This is because that they have little resources which makes them live in search areas that are more susceptible to disasters and have no timely warning systems. Furthermore, even if warnings were issued, they have fewer options for reducing losses in a timely manner.

In Uganda especially the Rwenzori region has not been spared by floods and they have left adverse effects. According to assessments undertaken during the Displacement Tracking Matrix (DTM) mobility assessment [10], it indicates that heavy rains experienced in recent years resulted into recurrent flash floods and water logging in valley and / low lying areas respectively causing varying effects on a number of sectors namely infrastructure, agriculture, education, health, water and sanitation. The frequency and intensity have since increased following the May 2013 flooding. The patterns of flash floods across the Rwenzori regions have been changing, and have become more frequent, intense and unpredictable on the local communities and have negatively affected community livelihoods [11]. Therefore, the study on long term river floods in Kasese district aimed for effective disaster risk management require findings on the strategies and scientific investigation on the flood's dynamics within the Rwenzori region areas particularly Kasese Municipality for improved livelihoods and hence economic development of the local community. It is for this reason that the study on assessing local strategies used in abating flash floods for improvement of community livelihoods in Nyamwamba division, Kasese district was initiated. The specific objectives that guided the study were: to establish the local strategies that have been used in abating flash floods for improvement of community livelihoods; to explore the challenges that have been faced during the process implementation of the strategies for abating flash floods for improvement of community livelihoods; and to determine the relationship between local strategies used in abating flash floods and community livelihoods. The study was of vital importance and tried to generate data that are of significance to different scholars about the local strategies that may be used in abating flash floods for improvement of community livelihoods and to ensure that the concerned stakeholders make informed decisions towards their adoption.

2. MATERIALS AND METHODS

The study covered the Kasese Municipality in Kasese district which is located along Mbarara Fort portal road, between latitude 0° 11' (0.1833°) north and longitude: 30° 5' 17.2" (30.0881°) east in Busongora county, Kasese district. The study area is about 385 Kilometers from Kampala, the country's capital city, via Mubende-FortPortal road. Kasese District is situated in the western part of Uganda. The study centered on studying the local strategies used in controlling long term flash floods and how to improve community livelihood in Nyamwamba and Bulembia divisions, Kasese municipality, Kasese District. This is because, the area has of recent been ravaged by flashfloods, destroying lives and human property. This study embraced a descriptive cross-sectional survey with both quantitative and qualitative data structures where the researcher collected information from a sample that was drawn from a predetermined population [12]. The descriptive cross-sectional survey design provided information about the variables in regard to local strategies and community livelihoods. Qualitative data helped to approve and supplement the quantitative information obtained from the study. A series of matching strategies were utilized to gather a

large sum of information with the advantage that the strategies upgraded the capacity for cracking the information captured as suggested by Hoggart et al. [13].

The essential primary data from the respondents during the study was collected using questionnaires. The questionnaire used to collect information was pre-tested in the south division of Kasese District which was not part of the study area. Pre-testing involved sixty respondents who were randomly selected. Pre-testing permitted the interviewers to familiarize themselves with the questionnaire and gave an opportunity to apply and audit the strategy as well as proved its validity. The aim was on assessing how the respondents comprehend the questions and to establish any problems encountered in giving answers. Changes were proposed, looked into and consolidated into the ultimate questionnaire. The questionnaire centered on the respondents' understanding of how local strategies applied in abating flash floods improve community livelihood in Nyamwamba and Bulembia divisions, Kasese District. The respondents were asked for their perceptions and opinions on the effectiveness of the local strategies in abating flash floods and improvement of community livelihood.

A questionnaire survey was conducted among 218 respondents from Nyamwamba and Bulembia divisions in Kasese Municipality, Kasese district. The sample size used in the study was obtained from a population of 480 local residents who live in the Nyamwamba valley. The sample size was determined using Yamane [14] formula, at the 95% confidence level. The sample size was determined, $n=N/1+N(e)^2$; $n=480/1+480(0.05)^2$; $n=218$. The respondents used in the study were randomly selected. One household head and in his/her absence, a grown-up individual aged 18 years or above from the selected category was then selected, and educated that the reason of the study was absolutely scholarly and had no implications at all, and that the respondent's secrecy and anonymity was guaranteed. The questionnaire was at that point administered to the respondent in form of interview and in the common dialect.

Information from key informants who hold highest posts at the local government in the departments Natural Resources and Forestry from municipality and local council leaders and some officials from the Office of the Prime Minister which deals with disaster responses in the country, were collected using the designed interview guide. The respondents were purposively selected in order to acquire expert's opinion about the topic of study. Their answers on the variables were compared to determine the effectiveness of local strategies used in abating flash floods. Purposive sampling of the respondents provided to the study a rich background of information to the topic under study [15]. Additionally, direct field observations were made on what is undertaken in the catchment zone to ascertain adapted local measures which the local communities are using to counter floods in the areas. Digital photographs were used to represent the information directly observed from the field which verified the reliability of the information the research participants provided during the survey regarding the local strategies applied in mitigation of floods in the area aimed at improving the community livelihoods.

The information collected using the questionnaire were edited, coded and analyzed using the SPSS version 22.0. This informed descriptive and inferential statistics to help communicate findings in a clear effective and visually appealing manner inform of graphs and contingency tables for visualizing trends of floods and their distributions in Nyamwamba division. Inferential statistics enabled generalization of the data while reporting on particular items in the study. Generalization ensured the extrapolation of the research findings to reflect the characteristics of the entire population as specified by Bryman [16] and Sarantakos [17].

Information provided by the Key Informants was sorted and categorized into themes basing on some particular items of interest. Relationship between some variables were established using correlation analysis while the association of attributes within the study were tested using the Chi-square test.

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics of the Respondents

Majority (52.8%) of the respondents were females and only 47.2% were males. Only 38.1 % of the respondents were within the age bracket of 20-29 years, equally, 38.1% of them were between 30-39 and 23.9% were of age 40 and above. About the 29% of the respondents

were single, 63% were married and only 8% had separated. Only 22.0% of the respondents were practicing farming, 19.3% were doing business, and the majority (54.6%) were in civil service. Almost a half (48.6%) had acquired primary level of education, 13.3% had qualified in secondary education, while 14.7% had certificate and 23.3% of the respondents were qualified with diploma. About 22.0% of the respondents had lived in the study area for 1-6 years and about half (48.2%) had lived in the study area for 11 years and above. This is an indicator that the study findings were captured from the people who had vast knowledge on the study subject in Kasese district. All the above are as shown in Table 1.

3.2 Local Strategies Used for Abating Flash Floods

The respondents were asked about the local strategies they are implementing to control flash aimed at improving their livelihoods. The findings indicate that restoration of river banks (69.3%), planting bamboo and trees along the river banks (68%) as shown in Plate 1, use of gabions to regulate flood's devastation (65.6), construction of dams to reduce the flow of water (65.6%), construction of channels to divert large volumes of water (95.9%), and terracing along the hillslopes (73%) as shown in Plate 2, were some of the strategies put forth to abate flash floods and hence aimed at improvement of community livelihoods as shown from Fig. 1 to Fig. 6.

The analysis in Fig. 1 indicates that 116(53.2%) strongly agreed,35(16.1%) agreed while 16(7.3%) disagreed, 23(10.6%) disagreed that restoration of river banks controls flash floods and improve community livelihood and 28(12.8%) were not sure. The findings are in line with Kousky [9], who suggested an institutional framework for managing floods focusing reinforcing physical river bank restoration using alternative ways like tree planting and living natural regrowth of the natural vegetation.

The findings in the study indicate that out of the 218 respondents 28(12.8%) of the respondents strongly agreed, 116(53.2%) agreed planting bamboo and trees along river banks combat flash floods while 41(19%) disagreed with variable as observed in Fig. 2. The findings are accordance with Fuchs et al. [18] who emphasized the public perception and information about floods in developing risk management plans using local strategies like planting vegetation, Terracing and construction of flood ways to divert flood waters. In relation to the stated findings, one of the key informants had this to say:

> *"Members of the community devised some of the strategies like planting bamboo and the trees along the river banks aimed at preventing the flash floods from breaking the banks and destroying their gardens. If they had not devised such methods, majority of the farmer's crops would be destroyed leading to some food scarcity amongst the population. The presence of such strategies have enabled members of the local community to improve on their livelihoods".*

Table 1. Demographic characteristics (Respondent's questionnaire survey, 2024)

Variable		Frequency	Percent
Gender	Male	103	47.2
	Female	115	52.8
Age (Years)	20-29	83	38.1
	30-39	83	38.1
	40+	52	23.9
Education Level	Primary	106	48.6
	Secondary	29	13.3
	Certificate	32	14.7
	Diploma	51	23.4
Occupation	Farming	48	22
	Business	42	9.3
	Civil Service	119	54.6
	Others	9	4.1
Years lived in study area	1-5	48	22
	6-10	65	29.8
	11+	105	48.2

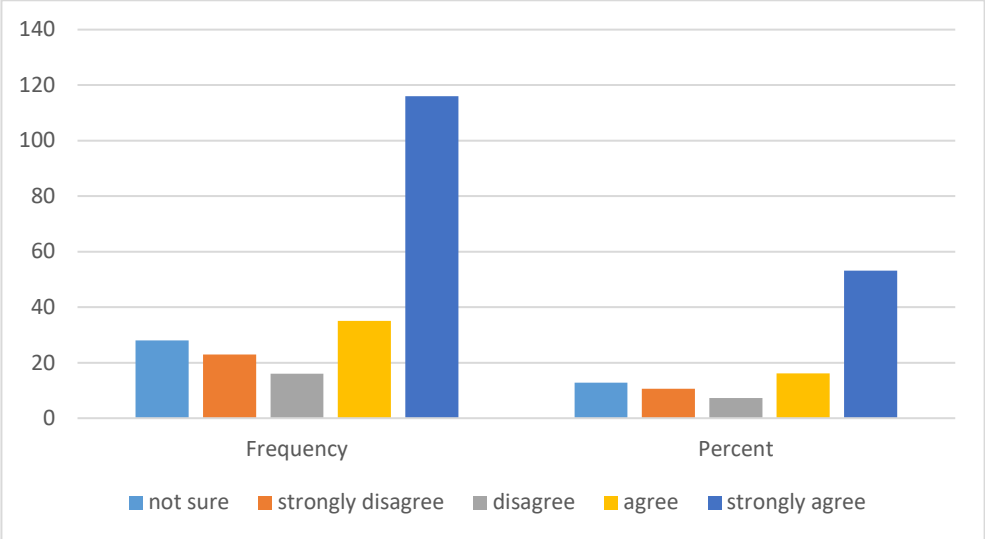

Fig. 1. Restoration of River banks, 2024

Plate 1. Bamboo and trees planted along the river banks (Masika, 2024)

Findings from the study indicate that 33(15.1%) strongly agreed, 110(50.5%) agreed that putting gabions along river banks control flash floods overflow and regulate floods devastation compared to the 33(15.1%) disagreed,26(11.9%) strongly disagreed and 16(7.3) were not decided on the variable under investigation as shown in Fig. 3. The use of gabions along river banks primarily to prevent erosion and help to stabilize the river banks also prevents landslides and maintain the integrity of the landscape.

The above findings are in line with Walker et al. [19], who argues that with the occurrences of extreme rainfalls intensified by high concentrations of impervious surface, flooding may be countered with the construction of gabions along the river banks which subsequently reduces adverse effects of flash floods. Some other authors like Barakagira and Kateyo [20] emphasizes that suitable approaches such as restoration of river banks, Construction of dams and river de-silting are likely able to mitigate environmental degrading activities like flash floods.

The majority 83(38.1%) of respondents strongly agreed, while 60(27.5%) agreed that when one

constructs check dams in flood plain, they minimize the risk of flooding on communities' property and life. Only 57(26.1%) disagreed, and 11(5.0%) strongly disagreed while 7(3.2%) were not decided as seen in Fig. 4. This implies that putting check dams in flood plain areas can be an effective method for flood control in flood plains because they slow down the flow of water allowing it to be stored temporarily in upstream areas. This is in agreement with Viglione et al. [21], who echoed that the capacity of a society to cope with flood hazards emerges from the interplay between hydrological and community processes of applying local strategies like dam construction for abating and minimizing the risks caused by floods. Ojelel et al. [22] asserts that when floods are controlled by planting trees and construction of dams, the ecosystem services are improved which may also tantamount to improvement of community livelihoods.

Construction of manmade channels diverts water and control floods. The findings revealed that 110(50.5%) strongly agreed 99(45.4%) agreed, 6(2.8%) disagreed 3(1.4%) not sure as shown in Fig. 5. majority 95.9% of the respondents extremely agreed this implies that construction of manmade channels as flood control measures help to manage flood waters by directing excess water away from vulnerable areas by use of floodways and diversion channels.

Plate 2. Terraces along the hill slopes (Masika, 2024)

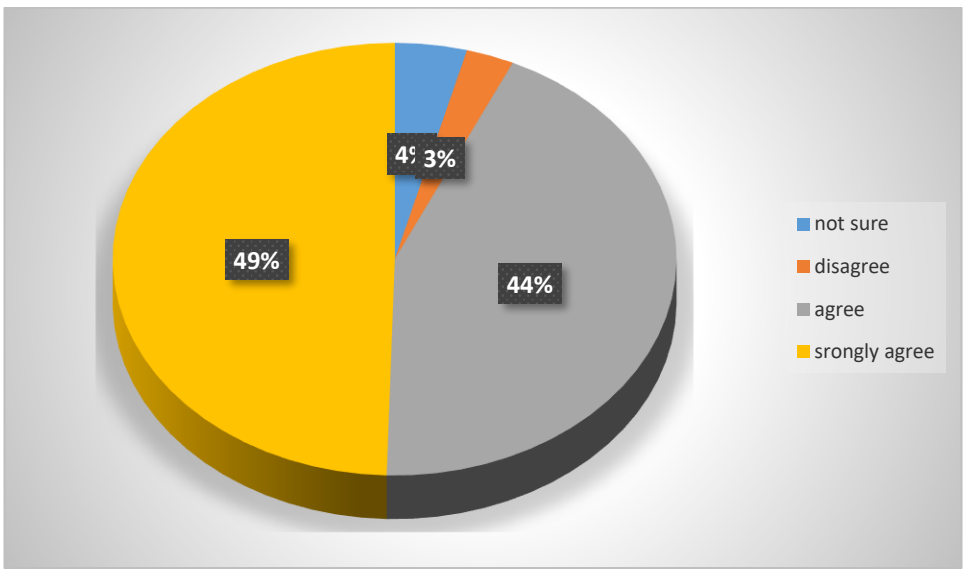

Fig. 2. Planting bamboo and trees along the river banks, 2024

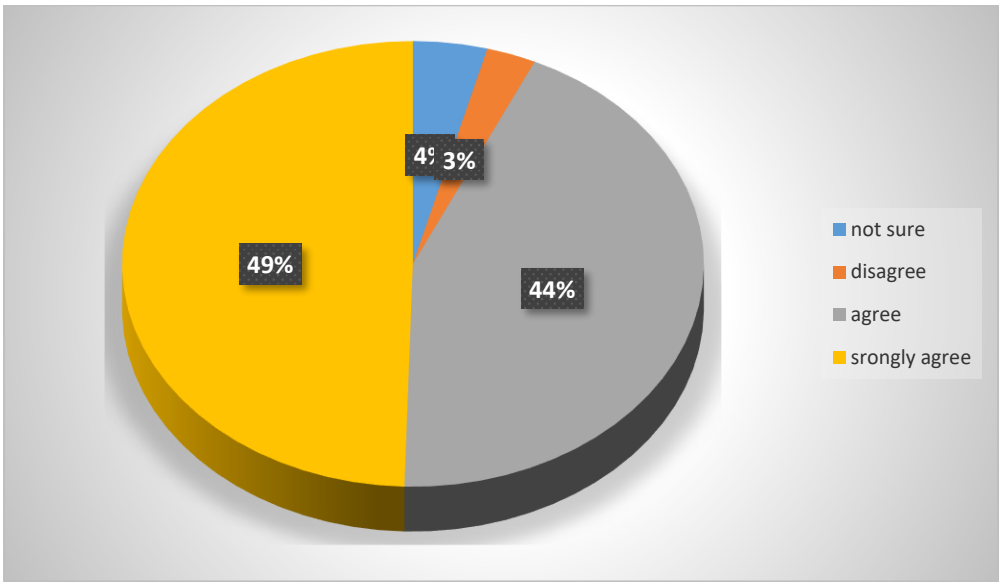

Fig. 3. Installation of gabions along the river banks, 2024

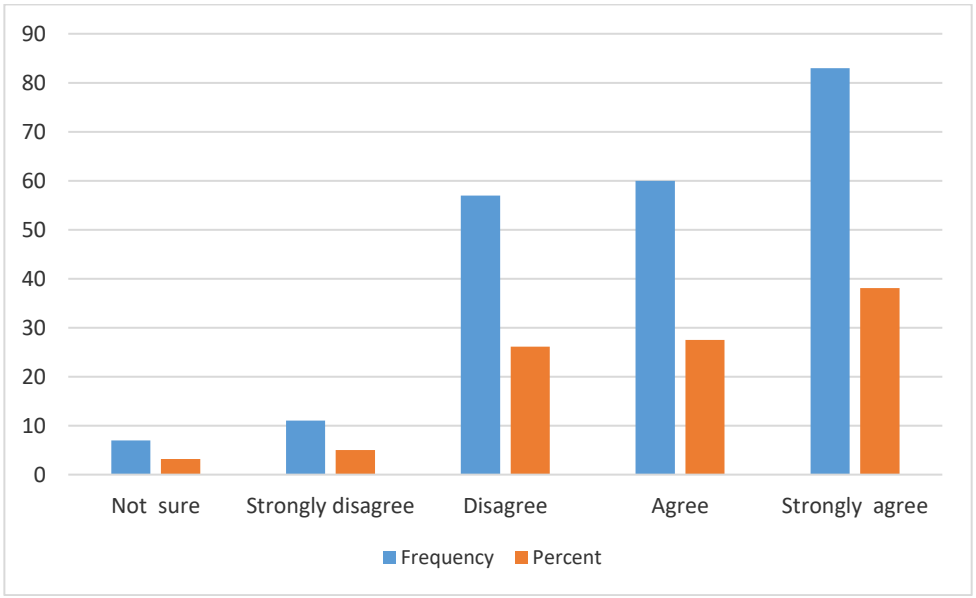

Fig. 4. Construction of dams in flood plains, 2024

Fig. 6 presents findings whether terracing along the hillsides which are flood prone areas are able to control floods. The findings showed that (73%) of the respondents sampled during the study agreed with the variable while (22%) disagreed and (4%) were neither sure nor had knowledge on the variable that was being investigated. The above findings imply that combining terracing on the hillsides with other flood control measures like retention basins and Zai pits [23], can create a more robust and resilient flood management systems, hence protecting community infrastructure and lives. Terracing along some hill slopes may improve some water retention and hence promoting productivity in an area which may improve people's livelihoods. This is in agreement with authors like Zenda Za Begani et al. [24].

3.3 Challenges Faced during the Implementation of the Local Strategies

A host of local strategies including restoration of river banks, planting of bamboo and trees, use of gabions, construction of dams and channels, and

terracing along the hill slopes were implemented aimed at abating the adverse effects of flash floods in the study area. However, during implementation, a number of the challenges were encountered by the local community. These include: financial constraints (81.2%), technical and logistical constraints (63%), poor infrastructural design (83.9%), and environmental related challenges (66.1%) as shown in Fig. 7 to Fig. 10.

The findings indicate that 109(50%) strongly agreed, 68(31.2%) of the respondents agreed that financial constraints limit communities to implement comprehensive flood management while 25(11.5%) disagreed together with 12(5.5%) who strongly disagreed and 4(1.8%) were not sure as shown in Fig. 7. Majority 81.2% of the respondents agreed with the variable and this implies that communities often lack the necessary funds to implement flood management strategies which are associated with high costs. The findings are concordance with Barakagira and de Wit [25] who stated that inadequate funding towards programmes aimed for natural resource protection stifled the implementation of the exercises.

On the technical and logistical limitations, communities often failed to implement comprehensive flood management strategies. The findings were that 86 (39%) strongly agreed and 52(24%) agreed, while 53(24%) disagreed 10(5%) strongly disagreed, leaving the 17(8%) who never made any response on this variable as shown in Fig. 8.

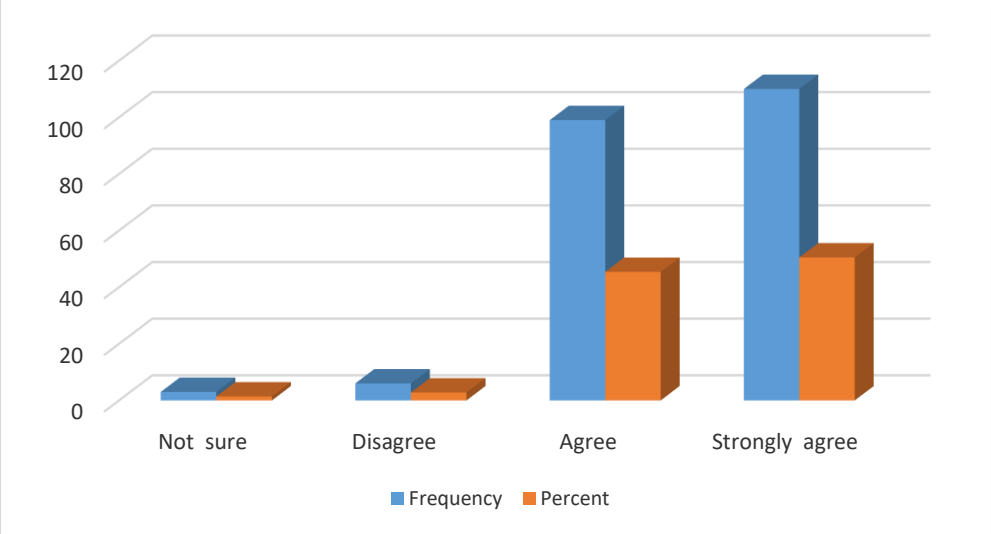

Fig. 5. Construction of channels to control floods, 2024

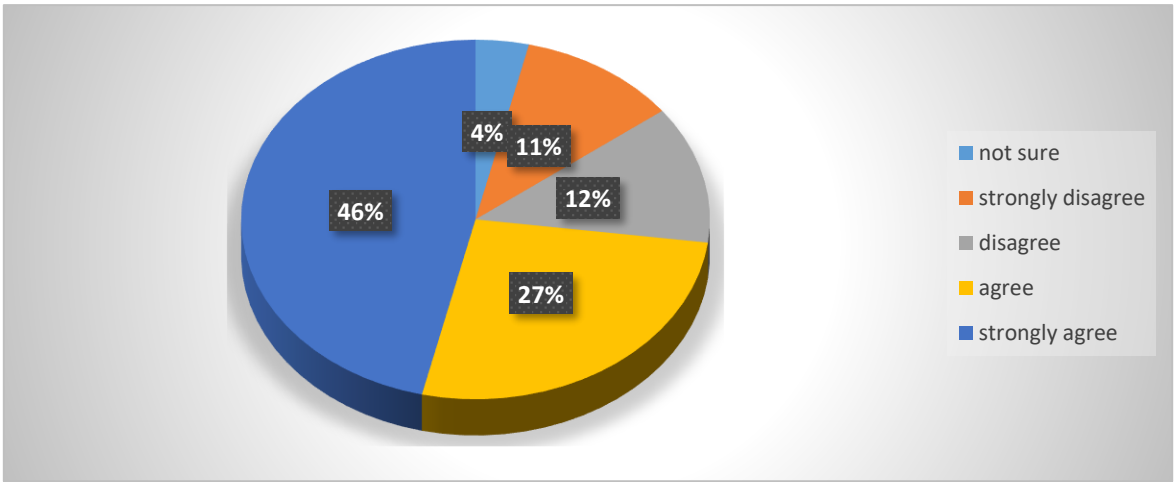

Fig. 6. Terracing along the hill sides, 2024

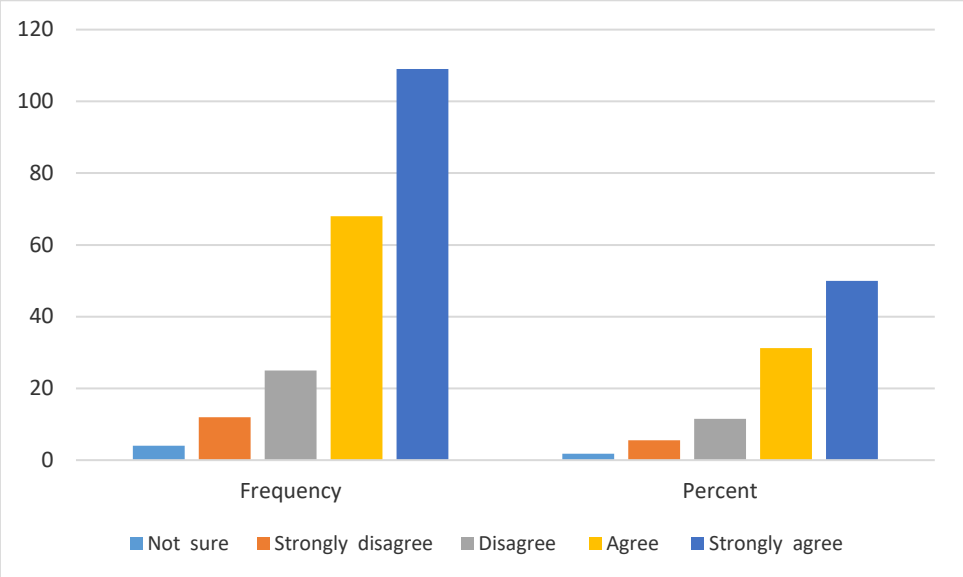

Fig. 7. Financial constraints, 2024

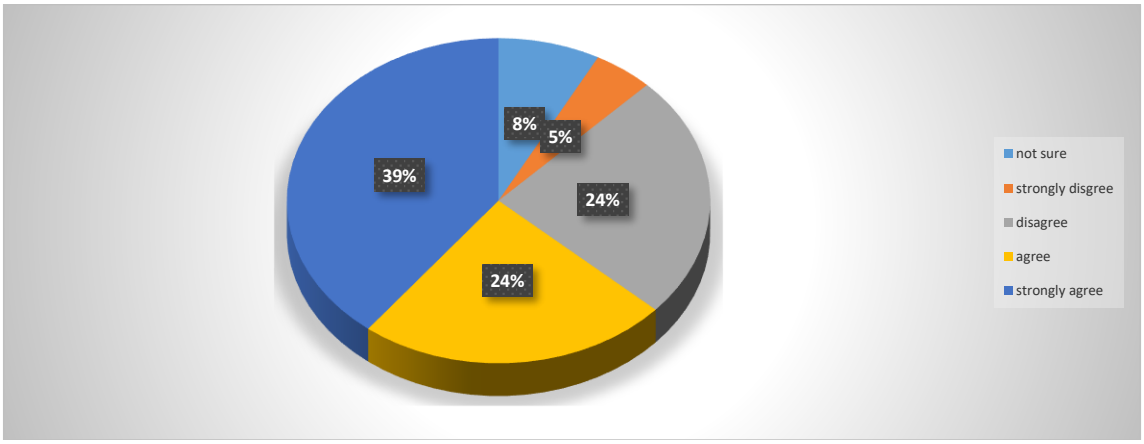

Fig. 8. Technical and logistical limitations, 2024

Majority 63% of the respondents massively agreed with the variable which implies that designing and constructing effective flood defenses require specialized technical knowledge and expertise which is not readily available at the local level. Some other authors like Barakagira and de Wit [25], Baguma and Barakagira [26] and Kalukusu and Barakagira [27] are in agreement with the findings who assert that lack of technical personnel that are well versed with the issues related with particular resources contributes to their degradation.

Findings from the analysis of data show that 72(33.0%) strongly agreed, and 111(50.9%) agreed that poor infrastructural design for flood mitigation structures such as dams, channels and drainage systems stifled smooth implementation of the local strategies. Among the respondents, 27(12.4%) disagreed while 8(3.7%) strongly disagreed with the variable as presented in Fig. 9. In establishing challenges that have been faced in implementing the local strategies in abating flash floods and improving community livelihood majority 83.9% of the respondents agreed which implies that when implementing local strategies to manage flash floods, good infrastructure and sustainable urban planning are paramount.

During the study, the findings revealed that 54(24.8%) of the respondents strongly agreed, 90(41.35%) agreed that environmental challenges such as climate change and land use changes reduced land's natural ability to absorb

water to reduce flood risks. Some 53(24.3%) strongly disagreed, 13(6.0%) disagreed while 8(3.7%) were not sure. Majority 144 (66%) of the respondents agreed with the variable. This implies that environmental challenges pose significant threats worldwide, primarily driven by anthropogenic activities which increase the frequency and severity of flash floods. This is supported by Vojinovic et al. [28] who suggested that preventing flash floods by hard infrastructures attracts new development in the floodplain, and induces catastrophic losses when the infrastructures fail. In addition, flood damage can be exacerbated by rigid, top-down approaches and increased uncertainty of flood events associated with climate change.

3.4 Local Strategies and Community Livelihoods

The relationship between the local strategies and the community livelihoods was determined during the study. The results are as presented in Table 2.

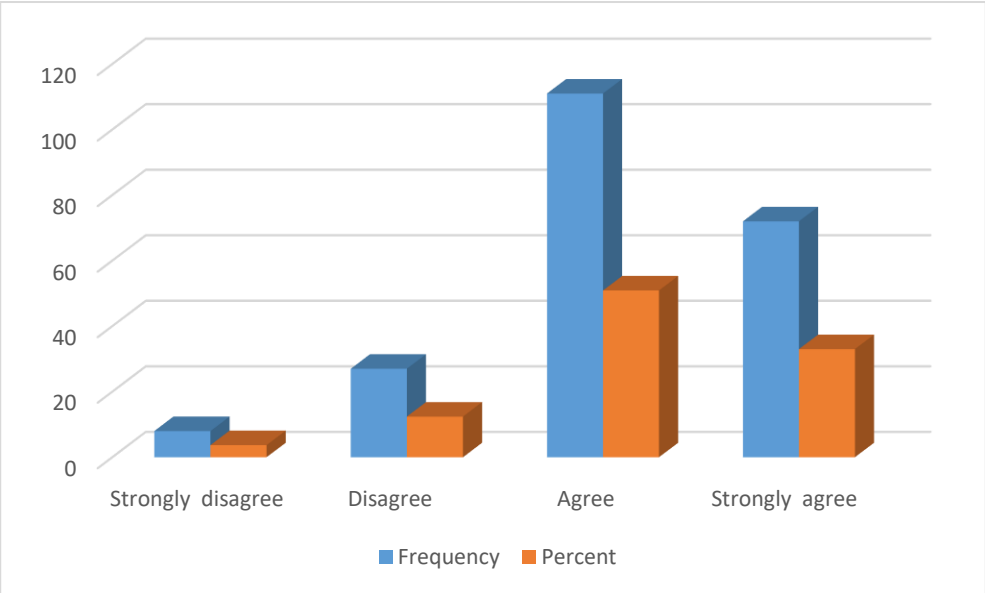

Fig. 9. Poor infrastructural design, 2024

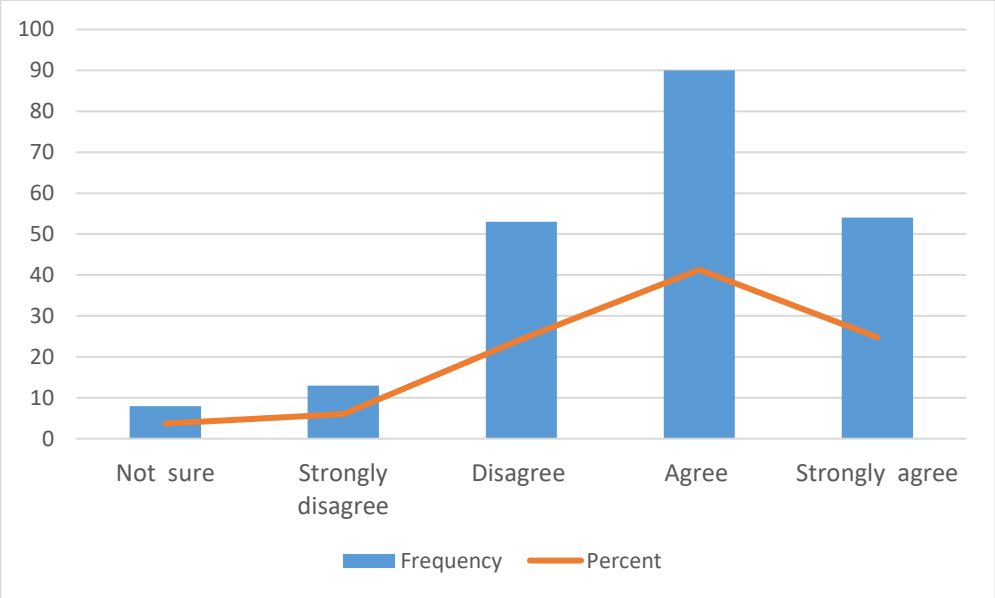

Fig. 10. Environmental challenges, 2024

Table 2. Relationship between the local strategies and community livelihoods in the study area (Respondent's questionnaire survey, 2024)

Local flood strategies help to preserve economic stability by protecting property and livelihoods	
	Frequency
Strongly disagree	8
Disagree	27
Agree	111
Strongly agree	72
Local flood strategies improve the drainage systems and help safe guard agricultural productivity and support local food security and income.	
Not sure	8
Strongly disagree	13
Disagree	53
Agree	90
Strongly agree	54
Effective flood management reduce risks and contribute to better community health and fewer disruptions to daily life.	
Not sure	53
Strongly disagree	6
Disagree	73
Agree	70
Strongly agree	16
Proactive flood management strategies lead to sustainable developments practices support agriculture and foster social resilience.	
Not sure	3
Strongly disagree	1
Disagree	17
Agree	24
Strongly agree	173

Considering the data from Table 2, the Chi-square tests were calculated and the results revealed that local flood strategies improved drainage systems and promoted agricultural productivity at P=0.001. The respondents who agree that the local flood strategies improve drainage systems and promote agricultural productivity are more likely to assert that the strategies enhanced their economic stability. In addition, another Chi-square test intimated that there was a moderate and positive relationship between the implemented local flood strategies and protection of community property and hence promoting community health at P<0.05. Related to the above, effective flood management strategies contributed to fewer disruptions to the daily life of community members at P<0.001. This therefore signifies that the proactive flood management strategies led to sustainable development practices and hence enhanced community resilience towards negative effects of climate change effects like flash floods. In line with the above findings, water conservation, landscape restoration, and some other integrated watershed management activities are more likely able to contribute to the protection of fragile ecosystems hence leading to the enhancement of community livelihoods [22,25,26,29,30]. Concerning protection of property and promotion of community health, Kalukusu et al. [30] stated that climate change effects caused a destruction of people's property and caused some disease outbreaks hence rendering them vulnerable and unproductive. The authors states that when such effects are countered, their livelihoods are likely to be improved.

4. CONCLUSIONS AND RECOMMENDATIONS

A host of the local strategies including restoration of river banks, planting bamboo and trees along the river banks, use of gabions, construction of dams and terracing along the hillslopes have been used for abating flash floods in the Nyamwamba and Bulembia divisions, Kasese District. However, financial constraints, technical and logistic constraints, poor infrastructural designs and environmental related challenges

have stifled smooth implementation of the local strategies. Therefore, implementation of some of the strategies including but not limited to the mentioned ones, are most likely to mitigate the effects of flash floods in the study area, hence protecting the lives, infrastructure and food crops for the members of the local community, hence improvement of their livelihoods.

The study therefore recommends that, a holistic approach incorporating community involvement, effective governance, resource mobilization and continuous monitoring and adoption of strategies to ensure a success in addressing the challenges should be adopted by Kasese district local Government.

Strong linkages between environmental management, infrastructure development early warning systems and community engagement is essential for regulating floods and protecting livelihoods. Therefore, Kasese municipal council leadership should integrate activities related to flash flood management in planning, budgeting and ensure implementation and compliance. In addition, strong institutional frameworks must establish clearly robust policies that support flood management disaster response and community resilience that is inclusive of clear roles and responsibilities among government agencies and other stakeholders.

Finally, flash floods have had far reaching and devastating effects on the livelihoods of the people in the Nyamwamba valley right away from affecting housing, health to agriculture and the economy. Therefore, effective flood management and disaster preparedness are vital to mitigate these effects and implementing local flood strategies is a complex and multifaceted challenge that requires a holistic approach thus adequate funding, community engagement and inter-agency coordination are very crucial for success.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

DATA AVAILABILITY

The data presented in the manuscript is available on request.

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We thank all our respondents who participated in the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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