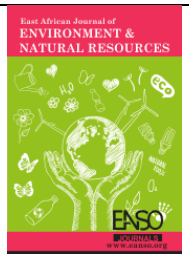

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Original Article

Assessing the Impact of Flooding on Livelihoods in Kamonyi District, Rwanda

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ABSTRACT

The general objective of the study was to investigate the impact of flooding on the livelihood of the Community in Kamonyi District. The Specific objectives were: to establish the causes of flooding, to assess the occurrence and intensity of flooding, to evaluate the livelihood of the community of Kamonyi District, to investigate the effect of flooding on biodiversity and to examine the coping mechanism. This study adopted a descriptive survey research design. The targeted population for this study included 838 farmers and 6 local leaders. However, given that this population was huge, sampling was conducted of this target population. The simple random sampling was applied in the selection of respondents from the farmers who use this marshland in cultivation, whereby 75 respondents were used as a sample and the Purposive sampling was used to select local leaders. Both primary and secondary data were used. Data collection methods included questionnaires, interview schedules and document review. In relation to the first specific objectives, Table 6 indicates that massive rainfall was identified as a major cause of flooding, accounting for 44.94%. Hydrological changes were also reported as a contributing factor at 14.50%. It is important for farmers to understand and follow advice given by local leaders regarding flood prevention in their cultivation areas. The sector officer in charge of agriculture must ensure that tools reserved for the development of modern agriculture are effectively utilised with proper distribution and allocation of resources.

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INTRODUCTION

A flood happens when a stream runs out of its confines and submerges surrounding areas The frequency and severity of extreme weather events and natural disasters have increased in the past decades worldwide (Giorgi, 2009). Flood is one of the main factors that prevent African populations from escaping poverty level. According to (Ajayi, 2007).

Flooding can be described as an overflowing of water into an area that is normally dry. The research carried out by Nott (2017) revealed that a flood event cannot be considered to be a natural hazard unless there is a threat to human life and/or property (McCusker and Carr, 2006).

An average of 70% of the population lives by farming; 40% of all export earnings come from agriculture, and about one-third of the national income in Africa is generated by agriculture (Yaro, 2004). Many countries have experienced flooding in recent years in Africa (e.g., Mozambique), Asia, and Latin America. Globally, it is reported that floods account for 34% of the natural disasters worldwide (Petit-Boix, 2017). Climate changes (intense rainfall and global warming) and anthropogenic pressures (urbanisation and deforestation) make floods more common and destructive (Rezende, 2021). Extreme floods have submerged large areas, including 27% of cropland in the world (Ballesteros-Canovas et al., 2020) and caused huge damage to plants (Mahmood, 2017)

These climatic change and its effects are the main cause of this study. This particular study adds value in this context and postulates the need for REMA to quantify in monetary terms the losses incurred during the 2012 wet season. Specifically, the research evaluated the economic costs in monetary terms of the 2012 floods on agricultural production, household livelihoods, and development infrastructure in the study area (Nkuriza, 2019)

Problem Statement

In Kamonyi District, it is observed that the District is facing a climate change related effect where, in the last 4 years, rainfall has increased from the range of 245mm to 425 mm in 2018 and the range of 445mm to 545 mm in 2021 (www.meteo rwanda.gov.rw). That resulted in high precipitation and high degree of surface run-off which significantly affected the agricultural production of vegetables and rice cultivated in wetlands surrounding the urban areas in Kamonyi District. Disaster records in Kamonyi district (September 2013 to November 2021) indicated that 6 deaths and 20 injuries occurred; 250 houses, 16 classrooms and 10 bridges were damaged; 65 ha of crops and 10 livestock were also damaged, and there were various landslides and biodiversity degradation that occurred in different regions of Kamonyi District.

However, none of these researchers have ever attempted to demonstrate whether the biodiversity dissatisfaction is caused solely by floods, nor have they shown the rate at which this affects biodiversity. Therefore, the current research will focus on proving the impacts of floods on biodiversity conservation, especially the flora and fauna observed in Kamonyi District. The research will use the participatory approach to consult farmers and ensure that the findings will be obtained with the existing information related to the topic under study (Kankindi, 2023).

DATA AND METHODS

Description of the Study Area

Kamonyi District is one of the eight Districts that make up the Southern Province. It is located in the central region of the country. It is composed of 12 Sectors, 59 Cells and 317 Villages (imidugudu). The District of Kamonyi shares its borders with Ruhango District in the South, Muhanga District in the West, Bugesera and Nyarugenge Districts in the East, Gakenke and Rulindo Districts in the North. (District Report, 2019).

A targeted area of study is located within three sectors as well as Runda, Rugalika and Nyamiyaga, in Kamonyi District. It is observed that the District is facing a climate change related effect where, in the last 4 years, rainfall has increased from the range of 245mm to 425 mm in

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2018 and the range of 445mm to 545 mm in 2021 (www.meteo rwanda.gov.rw). That resulted in high precipitation and high degree of surface run-off which significantly affected the agricultural production of vegetables and rice cultivated in wetlands surrounding the urban areas in Kamonyi District. Disaster records in Kamonyi district (September 2013 to Nov 2021) indicated that 6 deaths and 20 injuries occurred; 250 houses, 16 classrooms and 10 bridges were damaged; 65 ha of crops and 10 livestock were also damaged, and also there are where various landslides and biodiversity degradation occurred in different regions of Kamonyi District. All the recorded catastrophes were mainly caused by dangerous flooding in 3 sectors of Kamonyi district, namely Runda, Rugalika, and Nyamiyaga, sectors.

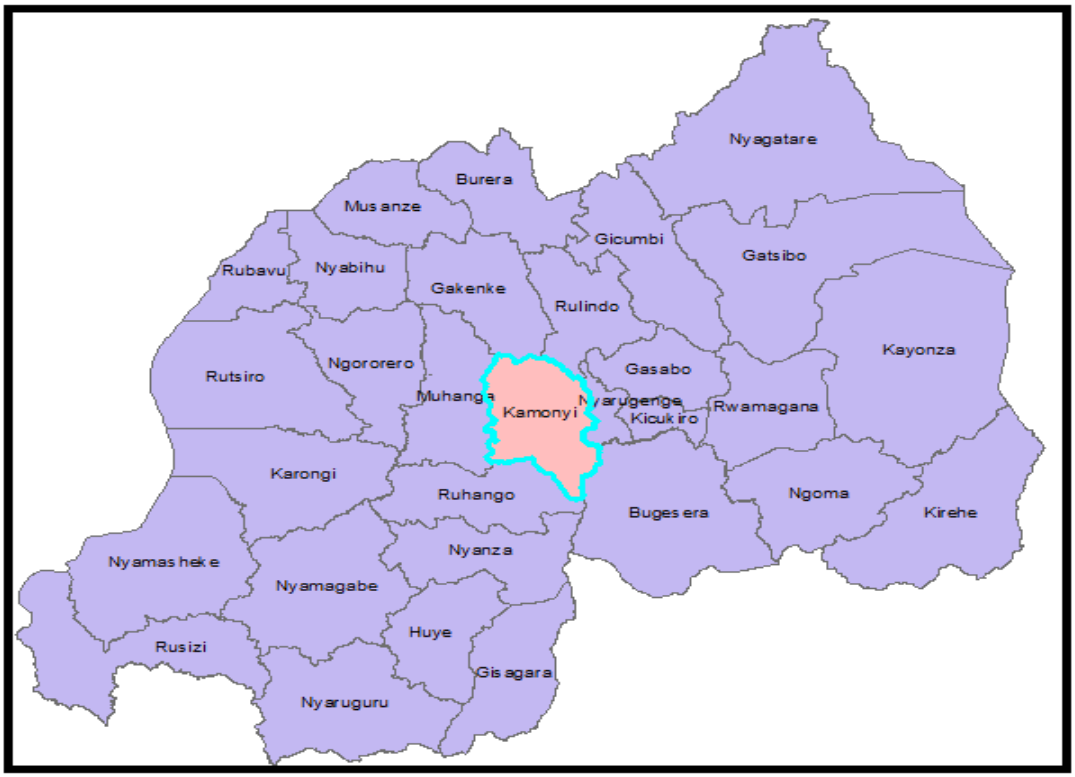
Environmental Aspect

The District of Kamonyi enjoys a moderate climate. The frequency of rainfall is rather sufficient and varies between 1.200 and 1.400 mm. The average temperature is 20ºC. (District Report, 2019). The soil of Kamonyi District is largely humus, permeable and fertile. The agricultural productivity increases year by year due to modern techniques of land use management.

However, the District is facing soil erosion and overexploitation due to demographic pressure. Parts of the District are occupied by a granite ridge and a sandy loam. (District Report, 2019). Its general relief is made of a low-lying plateau. The District of Kamonyi is located between 1.500 and 2.000 m of altitude. The Eastern and Northern parts of the District are occupied by the large valley of Nyabarongo. The highland peaks of the District are the following: Ijuru rya Kamonyi and "Cubina Marenga". Mukunguri and Kona kaMashyuza are the lowest points. (District Report, 2019).

Kamonyi District is drained by the great river Nyabarongo along the east and north of the District and Akanyaru River, which borders the District in the north and eastern part. There are also a number of small water courses, such as Kayumbu, Bakokwe, Gikoro, Mukunguri, Nyabuvomo, Bishenyi, Gatimbazi and Ruvubu. The District has approximately 843 water sources. (District Report, 2019).

Figure 1: Study Area Map



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Population of the Study

According to Manrich (1990), the term population simply wants to signify any group of people, or organisations, objects or events about which we want to conclude, while a case is any number of such populations. The study population refers to individuals, organisations, groups and communities that provide you with the information or you collect information from. Population refers to an entire group of individuals, events or objects having common observable characteristics (Oso and Onen, 2008). The Population for this study was 838 farmers and 25 local leaders. However, given that the population was huge, the sampling of the targeted population was conducted. This is taken from the ground as the source of the data.

Sample Size

According to Mbaaga (1990), the ideal research is getting data from the whole population because it would ensure wide coverage of all elements in the population under the study. A sample was chosen to represent the whole population. The research carried out by (Gall, 1996) comments that the study must consider a sample size that is within the cost constraint that should provide the ability to detect an independent variable effect on the sample size as being a phase of research, which is crucial because of its major impact on time and money that must go into data collection.

$$n = \frac{N}{1+Ne^2}$$

$$\text{Thus, } n = \frac{838}{1+ 838(0.10)^2} = 89 \text{ farmer respondents}$$

Where:

n = sample size

N= total population

e= margin error desired (10%)

Sampling Techniques

The term sample is the portion of the whole observation chosen to represent the main points of the study area and it is necessary to use the sample because it is not likely to be feasible to carry out research over the whole population due to time, space and material constraints (Kakooza, 1996). From this point of study, a smaller portion of the population was selected to represent the whole population in the area. Upon selecting the study's respondents, the researcher used both simple random and purposive sampling.

Simple Random Sampling

Simple random sampling, as defined by Baker (1988), refers to the situation whereby each case in the population theoretically has a chance of being selected for the sample. This method of simple random sampling was applied in the selection of respondents from the farmers who use this marshland in cultivation, whereby 75 respondents were selected.

Purposive Sampling

According to (Marlow, 1999), the purposive sampling technique purposively includes in the sample those elements of interest to the researcher. (Kaooza, 1996: 11) The researchers use his/her judgment or common sense regarding the participant from whom the information was collected. Bailey (1978) explains purposive sampling technique as a technique whereby the researcher uses their judgment about which respondents to choose and picks only those who can best meet the purposes of the study. In his research, purposive sampling was used on the local leaders.

Stratified Sampling

Stratified random sampling is one common method that is used by researchers because it enables them to obtain a sample population that best represents the entire population being studied, making sure that each subgroup of interest is represented (Punch, 2006). Stratified random sampling is a method of sampling that involves the division of a population into smaller sub-groups known as strata. In stratified random sampling, or stratification, the strata were formed based on members' shared attributes or characteristics.

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Data Collection

The techniques of data collection refer to the tools to be used for collecting data and how those tools were developed.

Sources of Data

According to Hornby (1963) defines data as facts or things certainly known and formed when a conclusion is drawn. In conducting a research study, the required data were gathered from both primary and secondary sources.

Primary Data

The primary data are the data that are collected and formed firsthand from the field. In doing so, the researcher meets the respondents at the research ground and asks them for the provision of ground-based realities (Azamia, 2013). With regard to the study, primary data was obtained from the board of directors, management and other stakeholders through questionnaires, interview schedules and observation methods. The methods adopted by the researcher to collect primary data include structured questionnaires directed to farmers from Kamonyi District.

Secondary Data

Secondary data is defined as the data gathering method that makes use of pre-existing data (Grinnell and Williams, 1990: 41). They also define it as the data that already exists in boxes, in some organisation's basement or hidden in the core of computers. Under this study, the majority included: various publications or print media which include textbooks, journals, newspapers, Government reports, previous theses, dissertations, research reports and newsletters. Electronic media, such as the internet, were used because it is the source of updated information. The secondary data for this study were gathered from existing documents, reports, textbooks and the internet.

Data Collection Technique

The data collected for this action research project was large in scope and it was collected using data collection instruments that were included in the analysis (Viernes, 2009). The sources of data can be outside or inside the area of research and the results from the operations of these sources are known as the facts used as a basis for inference.

The research instruments were used as a questionnaire and interview guide that were distributed to the key informants. To obtain useful and accurate data and ultimately come up with valid results, the researcher used the questionnaire, interview schedule and documentation.

Questionnaire

A questionnaire is an information gathering technique that gathers information about attitudes, beliefs, behaviours and characteristics from several respondents in the enterprise, who may be affected by a given phenomenon or system. (Kaooza, 1996: 11). This includes both open and closed-ended questions; the open-ended questions were intended to elicit the opinion of the respondents. In the views of Kendall (1992), the questionnaire contained a formalised set of questions that were used to collect information and later were analysed in order to provide the results necessary for solving the research questions at hand. The questionnaire was distributed to 89 farmers from Kamonyi District within 3 sectors, as well as Runda, Rugalika and Nyamiyaga

Interview

An interview is an instrument that is not given directly to the respondents, but is filled in by an interviewer who reads the questions to the respondent. In a case where the researcher had access to the respondents, she interviewed them and responses were filled in the interview schedule. For better organisation of the interview exercise, the researcher made appointments with the respondents in order to have access to them.

During the interview process, the researcher should have a list of questions that she reads to the respondent. The researcher prepared a separate schedule, as this would later facilitate the coding process. In this research, the interview was given

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to 25 local leaders, made up of 6 leaders at the district level, 9 leaders at the sector level, 3 leaders at the cell level and 7 leaders at the village level. The sample included 1 in charge of the environment and 1 in charge of animal resources at the District.

Documentary Sources

A documentary study is a careful reading, understanding and analysis of written documents for purposes other than social research. The record of past events that are written or printed. That documentation is the analysis of data that exists in boxes, in some enterprise's basements or hidden in the core of a computer.

In this research, the researcher collected the already existing data by finding them where they are stored or filed and these documents were related to entrepreneurship within the district and the rate at which it contributes towards the economic growth of the population. In addition, the quantification of the agricultural loss was essential as it helped in having information on the impacts of flooding on the livelihoods of the community of Kamonyi District.

RESULTS

This part of the research project is made up of the presentation, analysis and interpretation of the results obtained from the research questionnaire and interview guide. The part is also made of the presentation of socio-economic and demographic characteristics of respondents, while the second part of the research presents the information gathered from the research questions, objectives and the data that are reflected from the questionnaire.

Respondents' Profile

The respondents' profile mainly presents the basic information on the diverse aspects that encompass the basic information on age, gender, marital status, level of education and the occupations of respondents. The table below presents the information on the concern.

Age of Respondent

The table below presents the information on the age of respondents so as to understand the ways in which the age level may influence the responses from the respondents. The table below presents the age of the respondent:

Table 1: Age of Respondent

Age	Frequency	Percentage (%)
20-25	10	11.23
26-31	19	21.34
32-38	32	35.95
39-above	28	31.46
Total	**89**	**100%**

Source: *Primary data, February 2025*

The information gathered from Table 1 indicates that there are different age clusters, whereby the first round of respondents were the ones ranging between 32-38 years and this was presented at 35.95%. The second round of respondents is made up of those aged 39 and above and they were presented at 31.46%. Discuss how age relates to your research. In the same perspective, the next kin of respondents are made up of those with 26-31 years and they were presented at 21.34%. The lower number of respondents is made up of the young generation of 20-25 years and they present 11.25%.

This age diversity clarifies the level of responses as delivered from the respondents and also considering who among these age clusters is mainly involved in the cultivation. Of course, it is observed that the married generation (those aged 32-38) are the ones who frequently participate in the farming activity and they need to have more information than the young generation.

Gender of Respondent

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The classification according to gender is also important as it gives a clear message about the perceptions of respondents as per their gender diversity. The table below presents the information as gathered from the gender of respondents.

Table 2: Gender of Respondent

Gender	Frequency	Percentage (%)
Male	51	57.30
Female	38	42.69
Total	**89**	**100%**

Source: *Primary data, February 2025*

Table 2 indicates that a big number of respondents were male and this was presented at a rate of 57.30 %. The second round of respondents were female it was represented at 4.69%.

The inclusion of both males and females positively contributed to the acquisition of accurate information related to the research and this will also help the researcher to hear about the perception of the 2 genders with no bias. Link the gender with the research problem of your study. As the difference in gender indicates, the flooding affects the living standards of the entire population, hence the participation of both males and females. Beyond this, the agriculture sector is occupied by both males and females and this gives their entire participation in the area of the research, as they also become more affected by the occurrence of floods. For instance, some of the respondents to whom the research was concerned, especially in the interview, were female.

As observed in the table, a big part of the respondents are made up of males as they are the ones whom the researcher has met when trying to re-draw their chunks in the marshland, hence taking the big number in frequency and percentage than the females, but they are collectively considered to provide accurate information related to the research.

Marital Status of Members

The information gathered from the table below shows the classification of respondents according to marital status. The classification of these marital statuses has brought about the concerned information and understanding of the ways through which several classifications are made. The table below presents the information on the concerned matter

Table 3: Marital Status of Members

Marital status	Frequency	Percentage (%)
Single	21	23.59
Married	60	67.41
Divorced	1	1.12
Widowed	7	7.86
Total	**89**	**100%**

Source: *Primary data, February 2025*

The information presented in Table 3 indicates that the married generation of respondents was at 67.41%. The second round of respondents were in the single clusters at 24.59%. In the same perspective, the widowed and divorced generations were presented at 7.86% and 1.12% respectively. The implication behind this marital status classification is that the more the family become wide, the more it engages in different activities and this is the same phenomenon which was observed during the data collection, where the researcher found that the married group of respondents had a higher rate compared to other statuses.

The cluster of married generation is more frequent as they are the ones who were mainly occupying agriculture, and their responses were to be

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considered when drawing the conclusion and capturing the ideas in the research. Unlike the single and divorced who took the lower frequency, the single people are mainly the young generation who do not get engaged in agriculture in Kamonyi. The young generation prefers to engage in bicycle driving, hair cutting and other activities rather than farming. The same for the divorced generation. The respondents to whom the researcher met were not doing agriculture on a large scale, as they were the ones who were too old, and hence started shifting from agriculture to different marshlands.

Level of Education of the Respondent

When it comes to the presentation of education, the table below presents the relevant information on the level of education through which the participants have been educated and these are summarised in the table below:

Table 4: Level of Education of the Respondent

Level of education	Frequency	Percentage (%)
No formal education	15	16.85
Primary school	32	35.95
Secondary school	35	39.32
University studies	7	7.86
Total	**89**	**100%**

Source: *Primary data, February 2025*

The data collected from Table 4 indicates that the majority of respondents attended secondary school whereby it was with 39.32%, the second round of respondents were the ones who had attended primary school education and this was presented at 35.95%. In the same regard, the respondents who have no education were at 16.85% and the ones who have completed university studies were at 7.86%. The observation from the table above indicates that the education of respondents has a positive link to the understanding and acquisition of adequate information related to information and it helps in the management of information, as the level of education that someone holds becomes the gateway towards the acquisition of accurate responses. The existence of a large number of respondents who attended the primary school was that some of them were not able to continue secondary studies, hence got engaged in agriculture in large numbers as the area is in in rural zone where agriculture is mainly applied as the income-generating sector compared to other economic sectors like trade, service and manufacturing.

The respondents with a university level of education were mainly occupying the white colour jobs rather than doing agriculture, even if there were some of them who had parcels in the marshlands and this gave a sense of being asked about the flooding on the livelihood of people in Kamonyi. For their responses, the scientific and more analytical opinions were provided and this gave a clear image of how the flooding affects the living status of the people in Kamonyi District. This dissemination of the level of education significantly contributed to the acquisition of required data from the field and made the research richer and understandable.

Occupation of the Respondents

The information appearing in the table below is based on the occupations of respondents and clarifies the extent to which every activity that someone occupies delivers information on the subject matter:

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Table 5: Occupation of the Respondents

Occupation	Frequency	Percentage (%)
District officer	1	1.12
Sector officer	2	2.24
Cell officer	5	5.61
Village leaders	15	16.85
Farmers	51	57.30
Agricultural Cooperative leaders	10	11.23
Merchant	4	4.49
Handcraft activities	1	1.12
Total	**89**	**100%**

Source: *Primary data, February 2025*

The observed information from Table 5 revealed that the majority of these people who participated in the research ground were farmers, and this was at 57.30%. The second round of respondents was the village leaders, and this was presented at 16.85%. In the same perspective, the agriculture cooperative leaders were presented at 11.23% and the cell officers were at 5.61%. In the same regard, the lower number of respondents was those who are in the district officer and the handicraft activities and they were presented at 1.12% respectively. The occupation in agriculture as the main sector where flooding affects was considered the agriculture facts and this is why the majority of respondents were doing agriculture.

Findings from the Research Objectives

This part of the research project is made up of a presentation of information as delivered from the pre-established research objectives and the research questions.

The Causes of Flooding in Kamonyi District

As mentioned in the table, the flooding is caused by different and separate reasons that may occur across the time period. These causes either come from inside or outside the environmental control measures. These are shown below:

Table 6: The Causes of Flooding in Kamonyi District

Causes	Frequency	Percentage (%)
Hydrological changes	13	14.60
Massive Rainfall	40	44.94
Overflow of the rivers	10	11.23
Collapsed dams	5	5.61
Climate change	7	7.86
Deforestation	8	8.98
Emission of greenhouse gases	1	1.12
Urbanization	4	4.49
Total	**89**	**100%**

Source: *Primary data, February 2025*

The information as appearing on Table 6 indicates that the first among the causes of flooding in Kamonyi District includes the massive rainfall and this was presented at 44.94%. The second round of respondents said that the hydrological change is also among the causes of flooding, whereby it was shown at 14.50%. In the same regard, the overflow of the rivers was at 11.23% and the deforestation was presented at 8.98%. The lower number of respondents said that the urbanisation and the emission of greenhouse gases were presented at 4.49% and 1.12% respectively.

The responses on the same question about the causes of flooding in Kamonyi District, the district officer in charge of environment and

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replied that the flooding in the area is not caused by a single thing. From his point of view, the main cause of flooding is just the rainfall that is likely to occur during the wet season. The occurrence of this rainfall is also associated with a large part of the marshland that is likely to be denuded, hence resulting in flooding in the lowland areas. Other human activities like cutting down trees, overgrazing also have long-term impacts on the occurrence of flooding.

When linking with the past researchers' perceptions, the current research can be confronted with the findings from the research carried out by Daniel and Udo, (2019) whose research revealed that flood is an overflowing or eruption of a great body of water over land not usually submerged (It is an extreme weather event naturally caused by rising global temperature which results in heavy down pour, thermal expansion of the ocean and glacier melt, which in turn result in rise in sea level, thereby causing water to inundate coastal lands. Flooding causes inundation and harm to plants and animals, including man, buildings and infrastructure (Ujene and Oguike, 2020).

Similarly, according to Tabiri (2015), the four main causes of floods in Accra metropolis, Ghana, are negligence/ignorance or sheer megalomania, poor planning of the city, building on waterways and indiscriminate disposal of waste material. Tabiri observed that Accra is exposed to the challenges of flooding and that urgent measures need to be put in place in order to minimise the challenges of flooding in Accra. Among such measures are the development of good drainage channels to facilitate surface run-offs and the appropriate disposal of waste by relevant agencies.

The current research's findings are also similar to the findings from the research carried out by Komolafe et al. (2015) reviewed flood risk in Nigeria. They noted that there have been diverse flood events in Nigeria. Their study obtained data through past scholarly works and other secondary sources. They observed that flooding in Nigeria is caused by a high level of vulnerability and lack of coping capacity of residents in Nigeria, coupled with the rapid occurrence of extreme events resulting from climate change. Their study also revealed that flooding is increasing sporadically in the country due to poor urban planning and management.

From the above, it is evident that floods in the study area have posed a lot of problems for the inhabitants. These problems range from loss of personal effects, destruction of foodstufs and food resources, death of livestock, destruction of the environment including health problems such as malaria, diarrhea and cholera.

The Case Through Which the Flooding May Occur

There are several cases in which flooding may occur. The table below presents the information concerning the cases through which flooding may occur. The table below summarises the subject under consideration:

Table 7: The Case Through Which Flooding May Occur

Case	Frequency	Percentage (%)
The depth and volume of water	12	13.48
Water retention	14	15.73
Infiltration	9	10.11
Upstream forestation	8	8.98
Agro-forestry, river discharge	11	12.35
Higher rainfall intensities	15	16.85
Land degradation	20	22.47
Total	**89**	**100%**

Source: *Primary data, February 2025*

The information gathered from table 7 shows that the higher rainfall intensities was the first through which the erosion may occur is the land degradation and this was presented at 22.47%, the

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second round of respondent was insisting on the argument higher rainfall intensities at 16.85%, the next round of respondents said that the water retention was at 15.73%, other cluster insisted on argument of depth and volume of water at 13.48%.

The lower number of respondents insisted on the argument of infiltration and the upstream forestation and this was presented at 10.11% and 8.98% respectively.

The findings from the current research on this argument are similar to the findings from the research carried out by Hamilton (2019), who said that integrated flood management is about adopting the best mix of measures throughout the catchment to reduce flood risk and mitigate the consequences once a flood occurs. Plans include measures to increase water retention and infiltration, upstream forestation, agro-forestry, river border protection with gabion walls or bio-tactic measures, levees, storage ponds, wetlands, bridges and drainage infrastructure, enlargement and trimming of the river course.

Not less important are policies and policy enforcement and behaviour change for compliance with buffer zone regulation and keeping waterways clean. In addition, Karengera (2021) showed that the occurrence of floods is likely to harm the rural livelihood, especially during the rainy season, where there is a high rate of drilling and mass wasting that slide across the hillside, hence affecting the marshland topography and later impacting the living conditions of the rural people.

The Effect of Flooding on the Livelihood of the Community in this Area

There are different effects of flooding on the livelihood of community in this area and these either occur during times of drought of higher rainfall and others come during the time of drought. The table below shows the effect of flooding on the livelihood of the community in this area.

Table 8: The Effect of Flooding on the Livelihood of the Community in this Area

Effect	Frequency	Percentage (%)
Damage to properties	12	13.48
Loss of crops and livestock	13	14.60
Loss of human life	9	10.11
Health problems	7	7.86
Damage to roads	9	10.11
Recharge groundwater systems	5	5.61
Fills wetlands	6	6.74
Rise in sea level	8	8.98
Moves viable nutrients	7	7.86
Climate change	7	7.86
Heavy rains in the inland	6	6.74
Total	**89**	**100%**

Source: *Primary data, February 2025*

The data gathered from Table 8 indicates that there is a different effect of flooding on the livelihood of the community in this area, whereby the first among them was the loss of crops and livestock and this was presented at 14.60%, the second round of respondents insisted on the argument of damage to properties at 13.48%. The arguments of loss of human life and the damage to roads were shown at 10.11%. In the same perspective, the respondents who insisted on the argument of a rise in sea level were at 8.98%.

The fourth cluster of respondents insisted on the argument of health problems, moves viable nutrients and climate change and they were shown at 7.86%. The lower number of respondents said that recharge groundwater systems and the Heavy rains in the inland were at 6.74% and 5.61% respectively.

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The response from the interview guide on the same question revealed that there are cases through which flooding can occur, whereby the loss in agricultural yield, the occurrence of bans in transport facilities, especially in the ways that travel in the lowland, are the first among the effects of flooding on the livelihoods of the community surrounded by Kamonyi district. As some microorganisms live in the bush, and in water, when there is the occurrence of flooding, it may result in the loss of their shelters, hence resulting in the over competition between vegetation and animals searching for their residences. Another respondent said that the flooding leads to hunger, especially when it occurs and the crops of the marshland are taken away from the area and this seems to be a big challenge that the community faces despite the efforts made in the cultivation.

The findings from the current research on the impacts of flooding on the livelihood of the community can be compared with the findings from the research carried out by Looney (2012) on the economic impacts of floods in Pakistan, which studied the economic repercussions of the 2010 floods in Pakistan. These floods displaced 20 million people, 50,000 km2 of land was submerged, and standing crops and infrastructure were severely damaged. The economic cost borne by the country is broken down into categories that are direct/indirect. Assessment of the direct impact showed that seventy-eight districts were severely impacted, resulting in a death toll of 1980, with at least 2946 injured. Infrastructure damage includes more than 10,000 schools, 500 hospitals, and 1.6 million homes, and 70% of bridges and roads were swept away (WB 2010).

In addition, the findings are related to the research carried out by Analytic (2010) found that 1.2 million sugarcane, rice, and Kharif crops, mainly cotton and vegetables, plus 1 million tons of food and seed stocks were destroyed. It also destroyed the country's textile sector industries. Flash floods led to the loss of around 200,000 livestock in the hilly zones of KPK and Balochistan. The outbreak of contagious waterborne diseases was also on the rise. The indirect impact emerged from the direct impact and is measured as livelihood losses and variations for the movement of merchandise and services.

The Solutions to the Challenges Faced by the Local Community during the Occurrence of Flooding

As per the encountered challenges, there are also proposed solutions that can be taken into account and ensure community safety. The table below summarises these proposed solutions that can be put into place to fight against the erosion.

Table 9: The Solutions to the Challenges Faced by the Local Community during the Occurrence of Flooding

Solutions	Frequency	Percentage (%)
Regenerative farming	12	13.48
Tree planting	13	14.60
Scientific understanding and analysis	9	10.11
Design a good drainage system	7	7.86
Plant vegetation	9	10.11
Create retention basins	5	5.61
Provide education and ensure the enabling mechanism	6	6.74
Information exchange and utilisation	8	8.98
Stakeholder involvement	7	7.86
Adaptive management approach	7	7.86
Monitoring and environmentally sensitive economic analyses	6	6.74
Total	**89**	**100%**

Source: *Primary data, February 2025*

The information gathered from Table 9 indicates that the first among the solutions to the challenges faced by the local community during the occurrence of flooding was the plantation of trees,

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whereby it was presented at 14.60%, whereas the needs of regenerative farming were presented at 13.48%. In the same perspective, the arguments of scientific understanding and analysis and Plant vegetation were presented at 10.11% and the argument of Information exchange and utilisation was presented at 8.98%/. Another cluster of respondents said that there is an argument for designing a good drainage system, Stakeholder involvement and the Adaptive management approach and these were presented at 7.86% of the total views of respondents who were in the research ground. The need to provide education and ensure the enabling mechanism and monitoring and environmentally sensitive economic analyses was shown at 6.74%. The lower number of respondents said that there is a need to create retention basins and this was presented at 5.61% of the total number of respondents who were in the research ground.

The responses from interview on the same question was that some of the coping mechanism in order to mitigate impact of flooding on livelihood of community surrounded by Kamonyi district as was asked to the different officers such as forestry and natural resources Officer, Disaster management Officer, environmental Officer, Animal resources Officer, Agriculture Officer, infrastructure Officer where they replied that The first among the mitigation measures to fight against flooding include the mobilization of people towards building the water control canals around rivers and this is helpful as it lead to the reduction of soil denudation and the occurrence of continuous erosion. The other officer said that the district and other partners of help the population plan for the season, hence the reduction in harm that is likely to lead to the removal of the soil's upper surface. The second respondent said that the role of farmers and the marshland users, through teaching and better use of drainage and irrigation, is among the methods that are applied in fighting against flooding in the area.

The findings on the coping mechanism are contorted with the findings from the research carried out by William, (2019) whereby it has been revealed that the sustainable livelihood coping mechanism framework which discussed the natural assets; like farmland, water bodies, nutrients cycling, forest reserves, economic trees and the biodiversity as a whole that the communities derive their livelihoods which are often affected during flood disaster.

Livelihood coping mechanisms in the study area. This section looks at the different types of livelihoods coping mechanisms employed by the communities in the aftermath of a flood disaster. These include: fish mongering, petty trading, zona mat weaving, thatch weaving for local roofing, twine-weaving, fishing, exchange of labour for food, contracting loans from social contacts, and trading in livestock.

The Time of the Year During Which the Area Experiences Heavy Flooding

Across the year, there are some times when flooding may occur. The table below summarises these cases and their respective percentages.

Table 10: The Time of the Year in which the Area Experiences Heavy Flooding

The time of the year	Frequency	Percentage (%)
In the rainy season	34	38.20
Every time	28	31.46
2 times a year	13	14.60
More than 2 times a year	14	15.73
Total	**89**	**100%**

Source: *Primary data, February 2025*

As shown in Table 10, there are several time series where flooding may occur. The first round of respondents said that the flooding may occur in the rainy season and this was agreed at 38.20%. The fact that the flooding occurs every time was presented at 31.46%. The fact that it happens more than 2 times in the year was presented at 15.73%,

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and the lower number of respondents was at 14.60%

Opinions of Respondents on Whether There Is a Role for Local Government in Fighting Against Flooding

In the fight against erosion, there are several roles that the local government plays. The table below summarises the opinions on whether there is a role for local government in fighting against flooding:

Table 11: Opinions of Respondents on whether there is a Role of Local Government in Thinging against Flooding

Opinions	Frequency	Percentage (%)
Yes	88	98.87
No	1	1.12
Total	**89**	**100%**

Source: *Primary data, February 2025*

Table 11 indicates that there is a significant intervention of local government at 98.97%, the second round of respondents said that there is no role of local government and this was agreed at 1.12%. The observation on the opinions of respondents on whether there is a role of local government in fighting against the flooding helped to know how the local government where people reside has directly or indirectly intervened in community collaboration in fighting against the severity of flooding. This could give a sense of how people and leaders at several levels of administrative units can collectively come together towards providing solutions towards the removal of floods in the area of the study.

Interestingly, the majority of respondents to whom the research was concerned said that the local government intervene on a large scale. The first instance is how the district, sector and the cells come to advise people how to prepare the land and keep preparing the water catchments in big affected areas like Bishenyi catchments and the reduction in flooding severity reflects the good living of people, especially when it comes to the management of land and its utilisation towards acquisition of agriculture yields.

The Interventions of the Local Government Area Aimed at Fighting Flooding

The respondents to whom the research was concerned said that there are several ways through which the local government intervenes in fighting against flooding.

Table 12: The Interventions of the Local Government Intervened are Aimed at Fighting against Flooding

The interventions	Frequency	Percentage (%)
People mobilization	24	26.96
Community intervention	22	24.71
Building water channels	12	13.48
Canyon's building	13	14.60
Proper use of marshland in the agricultural season	4	4.49
Construction of river bounds	5	5.61
Use technology in water management	9	10.11
Total	**89**	**100%**

Source: *Primary data, February 2025*

As shown in Table 12, there are different ways through which the local government intervenes in fighting against flooding, whereby the first of them was the mobilisation that is given to the people and this was presented at 26.96%, the argument that the community intervention in fighting against erosion was presented at 24.71%. In the same regard, the next round of respondents said that the canyons building was presented at 14.60%, the building of water channels was

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presented at 13.48%, and the use of technology in water management was at 10.11%. From the same perspectives, the lower number of respondents said that the construction of river bound and the community assistance in technical aspects were presented at 5.61% and 4.49% respectively.

These diverse ways through which the local government intervenes ensure that people and leaders at different levels have a big role in ensuring that flooding can be reduced, as some of the human activities, like the sand harvesting in some rivers like Kayumbu and Kanyonyomba, are among the causes of flooding. With this, the community mobilisation, community intervention, building water channels, construction of river bounds, use of technology in water management and any other kind of activity that can be assigned to the people.

The Area through which the Flooding is Likely to Affect

The flooding is likely to affect several landslide areas. This is because the soil structure and soil catena are among the determinants of the impact of flooding. These arguments are summarised in the table below.

Table 13: The Area through which the Flooding is Likely to Affect

Area	Frequency	Percentage (%)
In the marshlands	35	39.32
On top of the hills	28	31.46
In the contours	14	15.73
To the mountains without trees	12	13.48
Total	**89**	**100%**

Source: *Primary data, February 2025*

The table 13 shows that the first among the area through which the flooding is likely to affect was in the marshland and this was presented at 39.32%, the next cluster of respondents said that the flooding affects the top of the hill and this was at 31.46%, the fact that it affects the contours was at 15.73% and the argument that it happens on the mountains without trees was shown at 13.48%.

The topographic shape itself becomes the gateway towards flooding severity, as was shown by respondents. The reason why marshland has a high frequency is that the more the crop is cultivated in marshland, the more the land is likely to be used in the time across the year and lacks field fallow. The lowering of the field becomes a significant factor that causes the flood to be severe in the zones that are likely to be cultivated.

The Crops that are Likely to be Affected by the Flooding

The table below presents the crops that are likely to be cultivated in the marshlands that are likely to be affected by the flooding.

Table 14: The Crops that are Likely to be Affected by the Flooding

Crops	Frequency	Percentage (%)
Maize	13	14.60
Beans	24	26.96
Vegetables	18	20.22
Onions	23	25.84
Soja	11	12.35
Total	**89**	**100%**

Source: *Primary data, February 2025*

The information appearing in Table 14 shows that the first among the crops that are likely to be cultivated in the marshlands are likely to be affected by the flooding, including beans, and this was presented at 26.96%. In the same perspective, the onions were presented at 25.84%, the next round of respondents said that the vegetables were presented at 20.22% and the round of respondents said that they cultivate soja, and this is being presented at 12.35%.

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The Other Types of Diversity that Affect the Other Living Organs other than Crops

The information from the table below presents the data on the other types of diversity that affect the other living organs, other than crops.

Table 15: The Other Types of Diversity that Affect the Other Living Organs other than Crops

Types of Diversity	Frequency	Percentage (%)
Animals	23	25.84
Birds	24	26.96
Micro organics	21	23.59
Domestic animals	21	23.59
Total	**89**	**100%**

Source: *Primary data, February 2025*

The flooding does not affect only the crops. Table 15 indicates that other types of diversity that affect the other living organs other than crops include the birds and this was agreed at 26.96%, the arguments that animals were at 25.84%. In the same perspective, the micro-organisms and the domestic animals were at 23.59%.

In this perspectives, the findings on other types of diversity that is affect the other living organs other than crops as appearing in this research are also confronted with the findings from the research carried out by Nalza, (2018) whereby the research revealed that apart from the livelihoods of people that are affected, the micro organics are also affected by the occurrence of floods as it destroys the living standards of these animals and negatively affects their residences.

CONCLUSION

This study investigated impact of flooding on livelihood of Community of Kamonyi District, Rwanda, In the conclusion of this research, we observed that the farmers are likely to face the challenges of flooding due to the delay in cultivation and not follow some instructions as provided by the agronomist and the local government, they must understand the advices given by the local leaders about the prevention of floodings in the area where they cultivate. This will ensure the availability of foods and the protected land as the research revealed that some of the cause of flooding severity was the poor preparation of the water catchment where water can go beyond the channels and this is sometimes associated with the lower consideration of the occurrence of heavy rainfall that causes the erosion, the farmers are recommended to dig the water catchments halls so as to orient the water that could denude their plots.

As the farming activity is done in reference to the environmental conditions, the farmers are recommended to do significant consultation with environmental agencies like REMA and Meteo Rwanda so that farmers may cultivate having information on the land and the climatic conditions. This is justified by the fact that in Kamonyi District, it is observed that the District is facing a climate change-related effect where, in the last 4 years, rainfall has increased from the range of 245mm to 425 mm in 2018 and the range of 445mm to 545 mm in 2021.

As the flooding is among the biggest challenges towards agricultural productivity and the general environmental challenge, farmers are recommended to follow the guidance given by the environmental agencies and the local administration about the soil usability by consulting the environmental information.

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