INVESTIGATING THE CAUSES AND IMPACTS OF FLOODS INCLUDING COPING STRATEGIES: CASE STUDY OF BAKA AREA IN KARONGA DISTRICT, NORTHERN MALAWI

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ABSTRACT

This study examined the causes, impacts, and coping strategies of flooding in the Baka area. The study was conducted at the Baka area (Mwanyesha village), T/A Kyungu, Karonga district.

The study used observation and interviews to obtain primary data and secondary data was obtained through desk research by reviewing related kinds of literature and also the recorded data that was obtained from the Relief and Rehabilitation officer of Karonga district. This study used both qualitative and quantitative approaches and data was analyzed using Instant software package, Microsoft excel, and Microsoft word. The study involved 41 respondents: one key informant was from Karonga Relief and Rehabilitation Office and 40 respondents were people from the Baka area. Systematic sampling was used as the sampling technique while interviews and questionnaires were used as tools for data collection. According to the findings from the residents of the area and the Relief and Rehabilitation officer, it shows that human activities e.g. cutting down of trees for charcoal, burning bricks, cultivating on a flood plain, the geographical terrain of the area and the upper areas of Chitipa district which receive high rainfall with more water moving at a higher velocity thereby affecting low lying areas of Karonga district are the main factors leading to flooding in the area. Furthermore, the study also found out that the floods have many negative impacts on the villagers and that different coping strategies are employed before flooding (since they can predict that floods are likely to occur using their indigenous knowledge), during, and after flooding. Lastly, it was found out that some of the mitigations measures were put in place to help in reducing the impacts of floods and some of these measures are; construction of a dyke, strengthening of early warning systems, promotion of modern farming methods, and planting of trees on bare land and along the river banks though their implementations have been hindered by several factors which include economic and cultural among others. From the findings, the recommendations were made and if they can be followed then having a Baka area that is independent and resilient to disasters is possible. Thus, the policy that encourages communities especially in the rural areas to build houses using durable materials and staying

away from flood-prone areas must be strengthened. A permanent evacuation campsite has to be constructed to avoid having relocation campsites within the school premises; structural measures e.g. dam, temporal floodwater storage artificial levees must be constructed to trap excess water which can later be used for irrigation. Community initiated mitigation measures should be promoted to build the community's capacity and lessening the vulnerability to hazard.

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ACRONYMS/ ABBREVIATIONS

DRR: Disaster Risk Reduction

FAO: Food and Agricultural Organization

EAD: Environmental Affairs Department

GIS: Geo-Information Systems

UNDP: United Nation Developmental Program

UNODRR: United Nations Office for Disaster Risk Reduction

DRM: Disaster Risk Reduction

IDP- Internally Displaced People

ECA: Economic Commission for Africa

NGOs- Non-Governmental Organizations

T/A: traditional Authority

DoDMA: Department of Disaster Management

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CHAPTER ONE: GENERAL INTRODUCTION

1.1. Introduction

This project work is focused on investigating the causes and impacts of flooding at the Baka area in Karonga district mainly focusing on the most recent floods ranging from 2016 to 2020. Flooding as one of the environmental hazards possess a danger or risk to the lives and properties of people in the affected area. Therefore, flooding can be defined as the accumulation of an excessive quantity of water in an area without flowing away easily. The concept of flood refers to the extremely high flows of rivers, whereby water submerges flood plains or terrains outside the water-confined major river channels, (Ngwira, 2013). The rapid increase of flooding had rendered agricultural and commercial activities even residential land use had been degraded or damaged in places near the north Rukulu river specifically the Baka area in the Karonga district. Furthermore, flooding does not only damage properties and endanger the lives of people and animals but also produces other secondary effects like an outbreak of diseases such as cholera and malaria which affects the wellbeing of people across the world negatively. According to UNDP Report (2004), it was found that regardless of many factors that cause floods like meteorological factors, hydrological factors, and Anthropological factors, the flood hazard nowadays is mainly a combination of all the factors. As highlighted by the Department of Disaster Management (2016), in Malawi most floods are caused by all three factors stated above but the most dominant one is anthropogenic factors and it's observed that the frequency of natural disasters has been increasing over the years, resulting in loss of life, damage to property and destruction of the environment. The number of people at risk has been growing each year and the majority are in developing countries with high poverty levels making them more vulnerable to disasters (Mwape, 2009).

1.2. Background information

According to Mwape, (2009). The Third Water Forum: poverty and floods held in march, 2003 indicates that in recent years, floods had become more frequent and of increasing severity resulting in loss of life, injury, homeless, damage to infrastructure and environment as well as impacting on other critical sectors such as education and agriculture. To concur with Mwape, in the study area floods results in the disruption of education since schools are used as evacuation centers as well as some structures collapse and there is also heavy damage caused to agricultural produce where maize and rice are washed away by the overflowing water thereby leading to food insecurity in the area.

Ngwira, (2013) says the frequency of natural disasters mainly flooding in Karonga district has been increasing over the years resulting in damage of property, disruption of social activities like farming, education, spreading of waterborne diseases i.e. cholera causing damage to the environment. The figures of vulnerable people have been increasing each year and the multitudes are people living below poverty levels making them more prone to disasters.

Mwape, (2009) argues that due to high levels of poverty, people have become more vulnerable because they live in hazardous areas including flood plains and steep hills. They have fewer resources which makes them more susceptible to disaster. They are less likely to receive timely warnings. Additionally, even if warnings were issued, they have fewer options for reducing losses promptly. The poverty levels also affect the ability of people in the affected area to resist and recover from a disaster. Therefore, it's the aim of this study to investigate the causes and impacts of floods to put in place the mitigations or adaptations measures to reduce the vulnerability of the villagers in the area. Findings of the study on causes, impacts, and coping strategies will help in DRR in the study area.

1.3. Statement of the problem

The problem being addressed in this study is the causes and impacts of floods in the Baka area in the Karonga district. The study area is in a low lying area of Karonga and Karonga is generally a flood-prone district that is situated in the lift valley basin where apart from floods it also prone to disasters like earthquakes and storms and it covers a total area of 3,355 square kilometers with a total population of 61,608 people (National Statistical Office, 2018). It also lies on the northern shore of Lake Malawi experiencing floods from February to March but also extending to late April in some years like the floods that happened on 21 April 2021 that washed away the Iponga bridge. The villages targeted in the area are located along the north Rukulu river which flows into Lake Malawi and the main factors leading to flooding in the area are human activities, geographical terrain, and rainwater from upper areas of Chitipa, and the large part of the land is used for growing crops e.g. rice, maize, and sweet potatoes.

Floods have lead destruction of houses, farmland unproductivity, and increased stagnant water sources causing malaria outbreaks which result in the death of people thereby reducing manpower participation in the developmental projects within the study area.

Furthermore, the effects of flooding have led to deplorable conditions for people living in the affected areas making many people either evacuate or abandon their houses, farming is no longer encouraged, commuters and transporters are faced with the problem of flooding of route and destruction of bridges. For example, the floods that happened on April 4, 2017, washed away the bridge at Jarawe (near Chiweta) causing major traffic disruption to and from Karonga and hindering the delivery of relief supplies to those affected in the area and similar floods occurred in the Northern region including in the study area in Karonga on April 2016 where at least 12 people died and 9000 were displaced. (Richard Davies in Africa news, 2017). Therefore, it's important to assess flooding in the Baka area in Karonga district to provide the adaptations and mitigations measures to reduce the resulting impacts though most studies have not been done in the area so far regarding the topic.

1.4. Objectives of the study

1.4.1 Main objective of the study

The main aim of this study was to investigate the causes, impacts, and coping strategies of floods in the Baka area in the Karonga district.

1.4.2 Specific objectives

The study-specific objectives were as follows:

i. To identify the causes of flooding in the Baka area
ii. To examine the impacts of flooding on people living in the study area and surroundings.
iii. To find the coping strategies employed in the area before, during, and after flooding and strengthen the positive coping strategies.

1.5 Research questions

By using Baka as a case study, it helped in answering the following questions:

- What is the meaning of the word flood?
- What are the causes of persistent floods in the Baka area?
- What are the impacts of floods on the people in the Baka area and surrounding?
- What are the coping strategies used in the area to avoid, reduce or adapt to the impacts of flooding?
- What are the factors that hinder the implementation of the coping strategies identified?

1.6 Significance of the study

This study of floods was very important because it helped in finding out the possible causes and impacts of flooding in the study area and this will be followed by the development of a contingency plan for an area under study so that the government, well-wishers, international organizations and local non-governmental organizations when they want to help the affected people in managing or recovering from the flood impacts they should know exactly what to provide to the people by using the area's contingency plan. The study will also help strengthen or improve the mitigation measures which are already employed in the community so that to reduce the impacts of hazard, for example identifying the suitable area that can be used as an evacuation center with the help from the government or NGOs instead of using the schools so that the education should not be disturbed in the community.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

Floods have been the topic of investigation for many years in Malawi and abroad. Many people have studied flood as an event concerning various pieces of knowledge such as hydrology, geomorphology, geology, water resources, natural hazards, and many more. In recent years, advancement in Remote Sensing and GIS tools and technology has made them possible to study distinct features (facets) of floods. According to the Government of Malawi. (2019), in early March 2019, Malawi experienced one of the worst tropical cyclones that formed in the Mozambican channel, bringing heavy rains and strong winds. Severe flooding negatively affected people's lives, livelihoods, and socio-economic infrastructure, pushing more people into poverty. In total, an estimated 975,000 people were affected, with 86,976 displaced, 60 killed and 672 injured. The devastating heavy rains and floods caused substantive damage and loss across the social, productive, and infrastructure sectors, with the social sector experiencing most of these effects. In the social

sector, the housing subsector experienced the greatest damage, with 288,371 houses being partially or heavily destroyed. Most affected people were accommodated in temporary (IDP) camps, mostly located in classrooms and school facilities, with limited access to safe water and sanitation facilities. This resulted in significant disruptions to learning and teaching activities at the school. In addition, the 2019 floods affected roads, bridges, power supply lines, irrigation infrastructure, and matured crops and according to FAO. (2009), the destruction of matured crops leads to the famine which is also a disaster leading to starvation hence the death of people and animals. Power supplies were interrupted for more than two days across the country. The Government and development partners responded swiftly to the disaster, immediately implementing rescue and relief operations that saved many lives and rapidly mobilizing resources to provide food and non-food items to people in the affected areas. However, most of the affected areas remained without shelter, requiring large numbers of IDP to be temporarily located in makeshift facilities and school classrooms, often with limited access to safe water and sanitation facilities. This use of school buildings disrupted schoolchildren's learning activities.

2.2 Causes and impacts of flooding

ECA and UNISDR (2015) states that most floods in Malawi results from heavy rainfall that creates excessive runoff in water bodies, leading to inundation and swelling of a flood plain and the risk of flood is further increased by human activities such as cultivation along the river banks and deforestation in the catchment areas. Certain decision-making processes must be followed to mitigate the danger of flood that causes tremendous loss of life and property. The reason for this research is to investigate the combined effects of topography and human activities, taking the case of the north Rukulu river which affects a lot of people living near the river. In Malawi, most of the floods are a result of human factors, trees and plants normally help to absorb too much water and when the forest is cut or burned down, water from the rainfall flows down barren land and produces mudslides. Too much water pressure in the dams or rivers leads to cracks in the concrete or even causes a dam or a

river to break completely. Mwape (2009) says the impact of disasters is usually measured in quantifiable ways, such as adding up the number of the dead and injured and estimating the physical damage to housing, land, livestock, agriculture, stores, and infrastructure and he describes flood as the most costly and wide-reaching of all-natural hazards. They are responsible for up to 50,000 deaths and adversely affect some 75 million people on average worldwide every year and are also associated with disease outbreaks commonly in less developed. Malaria and Typhoid outbreaks after floods in Tropical countries are also common countries. The term 'flood impacts' as defined by Fewtrell, Kay& Ashley (2008) refer to the broad effects that flooding can have on people, property, and to the environment. According to Richard Davies (2017). Malawi experienced normal to above normal rainfall within most of its regions and Karonga district, which is located in the northern part of the country, received above-normal rainfall on 4th April 2017 which resulted in flooding in most parts of the district where 4 people were confirmed dead on the same day, as of 6th April a further 3 people were still missing, 6 reported injured, 5,520 households were affected and 1075hectares of crop fields, including Rice, Maize, and Cassava, were damaged in areas of chief Kayunga, Wasambo, Kilupula, and Mwirang'ombe. It was also reported that similar floods occurred in the northern region, including Karonga, in April 2016 were at least 12 people died and 9,000 were displaced and people from the study area were using Baka primary and secondary schools as evacuation centers.

According to the study by the African Wildlife (2000), it was found out that the total impacts of human activities on the natural environment without regard for nature has turned the recent floods from a natural disaster into a man-made disaster evidenced by the frequency at which they occur. Floods in southern African have become more frequent and they take different forms. In some cases, especially in relatively flat areas, flooding involves total inundation of homes and infrastructure, and water may be stagnant for weeks. Under such conditions, the effects of flooding are not instantaneous but gradual. For instance, houses may continue being destroyed as they become weaker at the foundation and animals may die due to loss of access to food. Plants and vegetation that

do not like wet environments also die away. Southern African has been seen some of the worst flood disasters in the world during this century. The flood caused extensive damage to both primary and secondary road networks, bridges, and dams which are the life during drought periods. Many people lost their lives, homes were destroyed while crops were damaged extensively. A significant amount of fertile topsoil was lost through erosion in many of the flooded areas. With an abundance of stagnant water, the risk of an outbreak of waterborne diseases such as malaria and cholera significantly increased and drinking water was highly contaminated. Many boreholes were damaged which increased the risk of people contracting waterborne diseases. In Mozambique alone, the damage caused by the rains and floods was estimated at US $600 million (DMC 2000). Several factors can be attributed to occurrences of floods in southern Africa. According to the Government of Malawi. (2001), the factors include:

- Poor drainage system
- Highly meandering and unstable rivers (i.e. Songwe and Livulezi)
- High lake levels are rising from heavy storms such as cyclones cause severe flooding as experienced along Lake Malawi in 2003.
- The gradual encroachment of flood plain areas by human settlements and other activities, leading to a loss in the drainage capacity of rivers and streams and a reduced infiltration rate.

  EAD (2004), studied the flood causes and impacts in most parts of Malawi including Karonga, and concluded that the unchecked (deposition of silt on the river raised the river bed causing devastating floods). The impacts of flood hazards are (1) Massive bank erosion causing loss of valuable land and property, (2) Severe damage of life and properties including roads, railways, crops, and households, (3) Serious health hazards as the negative effects of waterlogging. Thus, the impacts of the flood on the people and society are direct and highly significant. Government of Malawi (2019). While floods cause severe problems on the environment, there are also positive elements that can be associated with them (CEDRISA, Droughts,

and Floods in Southern Africa: Environmental Change and Human Vulnerability, UNEP and SARDC, 2009). These positive aspects of flooding include;

- Cleaning process of ecosystems that have been laden with hazardous waste.
- Resuscitating ecosystems important for the tourism industry.
- Maintaining essential levels for water systems such as lakes and rivers necessary for navigation.

It's clearly shown in CEDRISA that once the floods are prevented through the measures put in place, the national and its people can benefit from it in many ways. For example, the resuscitation of ecosystems brings foreign currencies through tourism, and also floods bring about soil fertility to the flooded plain hence increasing agricultural production.

2.2.1. Possible solutions to flooding/ coping strategies

Water Directors of the European Union (EU) (2003): The report gives guidelines on important issues regarding sustainable flood prevention, protection, and mitigation. This document concerns rivers and flash floods. Floods are natural disaster, avoiding them it's almost impossible therefore mitigation, controlling and adaptation measures should be put in place instead. Some of the control measures are; afforestation in many areas in an attempt to reduce surface run-off by increasing infiltration, avoiding cultivation along the river banks to reduce the siltation of rivers.

The frequency and gravity with which the floods are occurring in Malawi, Mozambique, Swaziland, Zambia, and Zimbabwe call for the immediate adoption of long-term strategies intended at mitigating the effects of floods on the environment. The existence of early warning systems for flood forecasting and warning in these countries is viable and most useful too in mitigating flood impacts such as loss of life. However, there are crucial elements that need to be taken on board such as a complete review of the effectiveness of the systems, community responses, to flood warnings, education, and awareness on impacts of floods and how to avert them, and total examination of the structures in places

entrusted with dealing with the disaster. In the case of Malawi, only one basin, the Shire River Basin has a flood forecasting system that is used in warning people of any impending floods in the basin. The system established in the late 1970s has been rendered less and less effective due to catchment degradation which has induced changes in the river's cross-section configuration through scouring and siltation (Ministry of Water Development, 2003).

The measures developed by the government in 1996 to deal with floods could provide new ground alleviating the suffering that arises out of the disaster which has now become more frequent. The measures include (Government of Malawi, 1996 and 1998):

- Preparing flood zoning maps showing the relationship between the river stages and likely areas that can be inundated by floods.
- Prohibiting forest logging which influences land degradation and erosion of most catchment area.
- Development of adequate human and technological capacity for accurately predicting flood disaster and their extent.
- Preparedness for distribution of necessities before occurrences of floods that would be easily accessed by people after the occurrences of flood e.g. food and tents.
- Undertaking comprehensive research in flood mitigation measures. Such research would focus on the efficient use of flood-prone lands and how
- Improving flood awareness and information generation and dissemination, Information relating to flood could include:
    - Moving away to higher grounds upon being advised of an impending flood disaster
    - Prohibiting crossing of rivers when streams and rivers are in flood.

Note: According to Ariyanbandu and Wickramasighe (2005), defines coping strategy or mechanism a means through which a community and its members individually develop ways to deal with different damages/ circumstances influenced by disasters.

2.2.1.1. Coping strategies before flooding

Ngwira (2013) wrote that with an increase in technological information about the pending floods reach places faster than during the past when the technology was not advanced. To concur with Ngwira, in the study area during the past people used local means of communication e.g. drums and horns which could not reach people in time. But with the coming of social media, reports on radio and television people can get the information quickly hence having enough time to prepare for an upcoming hazard. Some of the coping means are: practicing food security by reducing the amount of food eaten per day and storing some food for future use, planting early maturing crops so that they mature and harvested in time in case of late floods like those happening in late April or early May.

2.2.1.2. Coping strategies during flooding

During flooding people generally cope with floods by practicing some of the following things: evacuating to the higher grounds, making boats using banana raft platforms in saving the lives of more vulnerable people like elderly people, children, and people with disabilities. The Karonga District Disaster Risk Management Plan (2014-2018) shows that in most areas affected by flooding like in the study area there is a Village Civil Protection Committee which assists the flood victims like relocating people into tents, rescuing flood victims especially the less privileged people who can't help themselves and also communicating the flood problems to the responsible officials on behalf of the community.

2.2.1.3. Coping strategies after flooding

Due to damages caused by flooding people lack different things after the flood incident is over. Some of them have relatives who help them during flooding and after flooding in terms of material support while others only depend on government, non-governmental

organizations, or well-wishers for support. Some of the coping strategies done after flooding are; repairing the damaged houses with the help from relatives or agencies, some altogether relocate to other places considered safe from floods, and planting trees along the river if it is considered to be one of the factors leading to flooding. People usually go back to their homes after flooding from the uplands where they were evacuated and this exposes them to the risk of floods again (Hoke, 2005).

From the literature review, we can deduce that the increasing population of our planet is resulting in increased exposure of people and property to the hazard of flooding. This is in line with the outcomes of the research which has confirmed that the population of people living along north Rukulu River in the study area has increased over the years and has made them vulnerable to flooding. With the increased population on our planet, it may be expected that the effects of climate change will further worsen this. It is stated that the chances of flooding can never be eliminated but the consequences of flooding can be mitigated by appropriate behaviors and actions taken by local people, government, or non-governmental organizations which are found within the district of far. Successful flood risk management depends much on active support from those people affected by floods, civil authorities, and the wider community with its leaders. Lastly, the coping strategies must be successfully executed in time both before, during, and after flooding so that the impacts of flooding are reduced.

CHAPTER 3: METHODOLOGY

3.1. Introduction

This chapter outlines the methodology used in the study which includes, research design, sample selection and size, data analysis, and conclusion on research design and methodology.

A descriptive research design was adopted for the study of flooding in the target area and a systematic sampling method was employed to come up with the sample population using the formula; r+ (n-1) k where n is the sample size, r is the random start and k is sample interval and is given by N/n, where N is the total population (Mann, 2001). The survey was conducted through a simple developed questionnaire by the researcher which was adapted in English and subjected to interpretation to other local languages well understood by the sample population. After finding a sample group, the researcher collected data on the impacts of flooding at both the community and household level as directed by the questionnaire.

3.2. Research design

According to different scholars, a research design is defined as all decisions made in planning the study, including sampling, sources, and procedures for collecting data, measurements issues, and data analysis plans (Mwape, 2009).

Mwape also says that the research design to be used depends on the purpose of the study, the nature of the research questions, and the skills and resources available to the researcher. To agree with Mwape, in selecting the appropriate research design for this study, the above approaches were taken into consideration. The study employed both quantitative and qualitative approaches. The study was conducted at the Baka area in Karonga district, Northern Malawi, and the area was chosen because it experiences floods almost every rainfall season. The researcher used questionnaires in collecting data at a village level where households were sampled using a systematic sampling technique and also an informant questionnaire which was meant for stakeholders at the district level.

3.3. Material and methods

3.3.1. Sample selection and size

As stated by Strydom, Fouche, and Delport (2005), sampling means taking any portion of the population or universe as representative of that population. It's generally stated that the larger the population, the smaller the percentage of that population the sample needs to be and if the population itself is relatively small, the sample should comprise a reasonably larger percentage of that population. Large samples enable researchers to draw more representative and accurate conclusions and to make accurate predictions than in smaller samples.

The target population for the study therefore is, households, community leaders, or Relief and Rehabilitation Officer, Karonga. The participants were selected using a systematic sampling technique.

Due to time and financial resource limitations, a sample of 40 household respondents which includes both men and women was used against total households of 378 which were systematically sampled and interviewed at a community level and this sampling technique helped in avoiding bias in the choice of participants at Baka area. A total of one (1) key informant questionnaire was given to a Relief and Rehabilitation Officer at a district level.

According to Mann (2001), the formula used in systematic sampling is; r+ (n-1) k where n is the sample size, r is the random start and k is sample interval and is given by N/n, where N is the total population.

3.3.2. Sampling instruments

This study used questionnaires to investigate the causes, impacts, and coping strategies of floods in the Baka area. The questionnaires are probably the most used instruments of all. In this study, the primary data was obtained from direct interaction with the respondents

at the household level and this makes the data very reliable and accurate. The questionnaires were divided into two, for the Relief and Rehabilitation officer and villagers. The difference between the two was that the villager's questionnaire was more detailed than the one prepared for the officer. This was so because the questionnaires for villagers were designed to obtain the specific data in the study area starting from the household to the entire community while for the officer was designed to give the general information about the community on impacts, causes, and coping strategies.

3.3.4. Data analysis

Strydom, Founde, and Delport (2005) define data analysis as a means of finding answers by the way of interpreting the data and results from the collected samples. To interpret is to explain and find meaning. Since it's not easy or possible to explain raw data, one must first describe and analyze the data and interpret the results of the analysis. In short, analysis means categorization, ordering, manipulation, and summarizing data to obtain answers to research questions. The purpose of the analysis is to reduce data to an intelligible and interpretable form so that the relations of research problems can be studied, tested and conclusions are drawn.

For this study, data were analyzed using SPSS Computer software package, Instat software package, and Microsoft Excel for data collected. This study required more explanations and some information was presented using graphs and tables for easy understanding purposes.

3.3.5. Study area

The geographical location of the study area

The study area is a low–lying, severely flood-prone area of Baka in Karonga district (near Karonga town) where most villages under the study area are located where the north Rukulu river passes. Karonga town has a population of 61,609 and has the following GPS coordinate; Latitude: -9.9333 and Longitude: 33.9333. Karonga district is the border district between Tanzania and Malawi and the chief town is Karonga Boma.

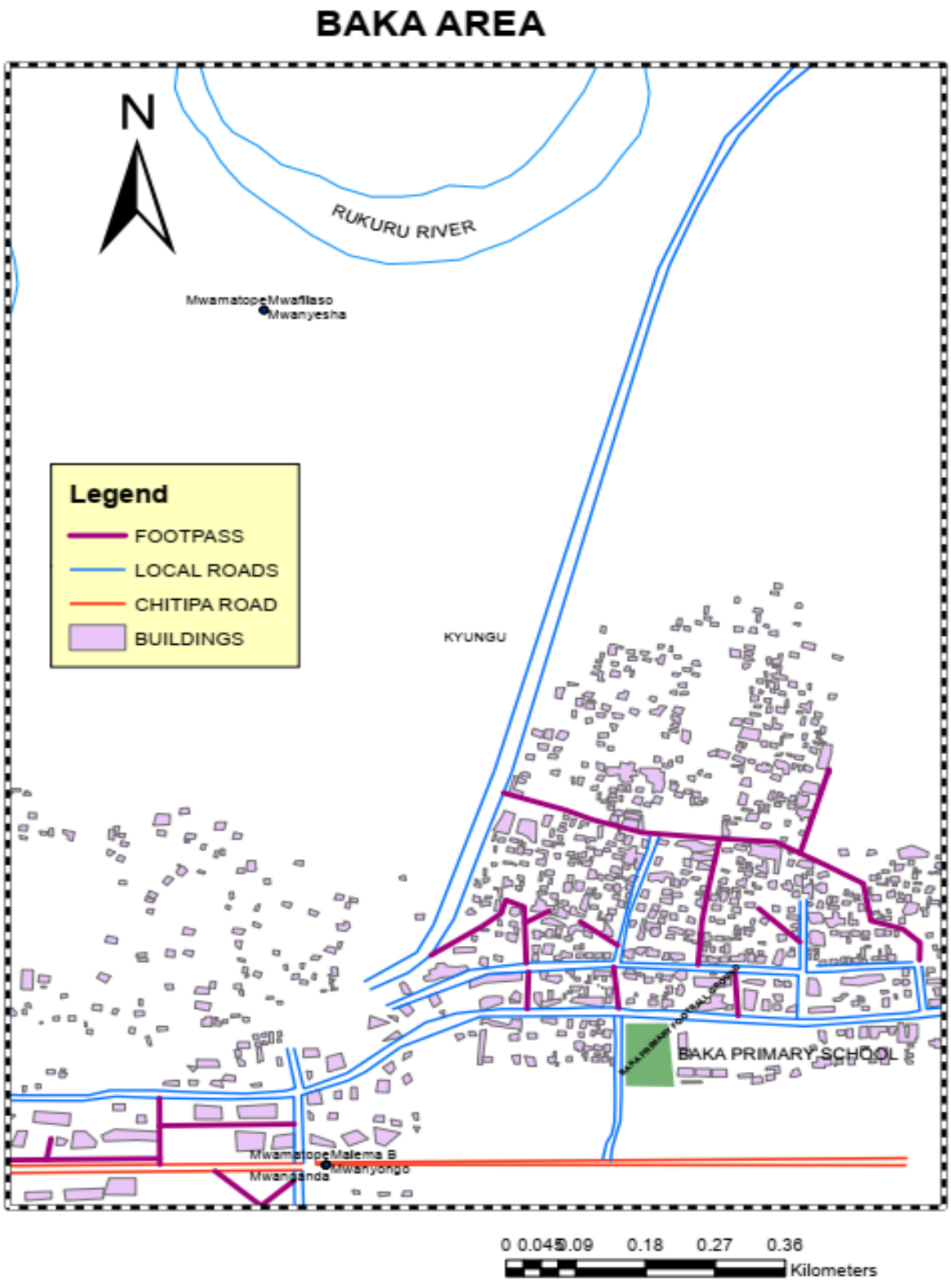


Figure 1: Shows the map of the study area in T/A Kyungu, Karonga district.

CHAPTER 4: RESULTS AND DISCUSSION

4.1. Introduction

This section provides a discussion on the research results based on the data collected through primary and secondary means. It provides a discussion on household demographic, flood knowledge, level of education, causes of floods in the study area, impacts of floods on various aspects, coping strategies, mitigation measures, interpretation, limitations, and implications of the study. According to the people in the study area, flooding is defined as the overflowing of water that the north Rukulu river has failed to accommodate and this overflowing water affects people negatively especially living in low lying areas in the study area

4.2. Household demographic

4.2.1. Gender of respondents

Table 1 below shows the gender of the respondents in the study area.

GENDER

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	FEMALE	25	62.5	62.5	62.5
	MALE	15	37.5	37.5	100.0
	Total	40	100.0	100.0	

Table 1 above shows that there were more women than men in the sample used. This is shown by the results where 62.5% were females and 37.5% were males. When the study was being conducted, there were more females than males because most men were engaged in different livelihood strategies since the researcher went to the study area at a

time when people were back from the evacuation camps to their homes. On contrary, if the study was conducted while people were still at the evacuation camps, more men could be expected to be involved in the study than women because more women could be out trying to source food so that their respective families should not starve. This agrees with Fordham (1999), who said that most of the times women are afraid of impacts or losses that are associated with a particular disaster especially flooding and have a feeling of insecurity and do not concentrate on any other work but putting much of their focus on how the family will survive through a disaster situation.

Furthermore, 69% of the households were headed by men, and the remainder headed by women. Additionally, 60% of the heads were of the households were married while 20% were widowed. In terms of the age of the households, the research findings showed that most of them were aged between 40 - 44 years and 54+ years as shown in figure 2 below.

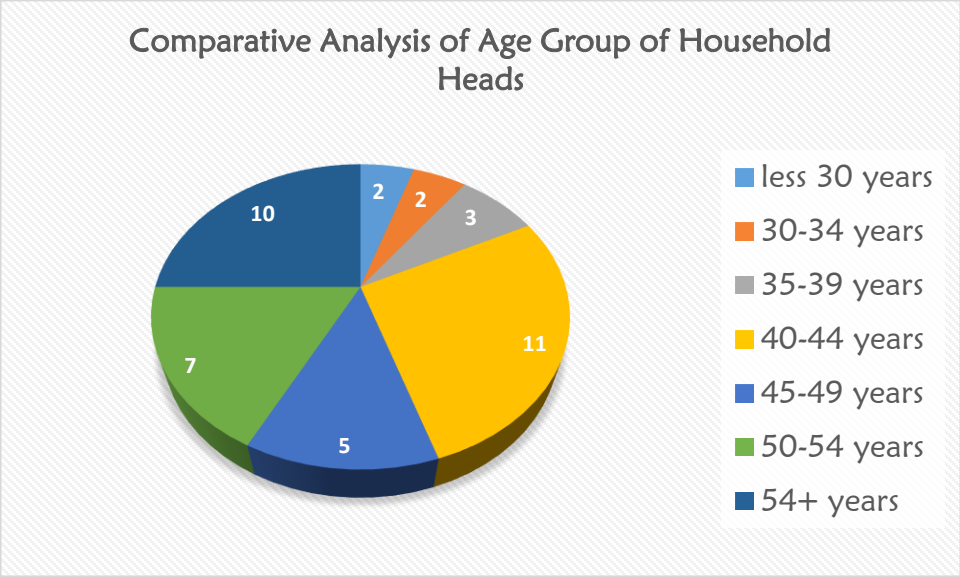


Figure 2: Comparative analysis of the age group of household heads

4.2.2. Flood knowledge

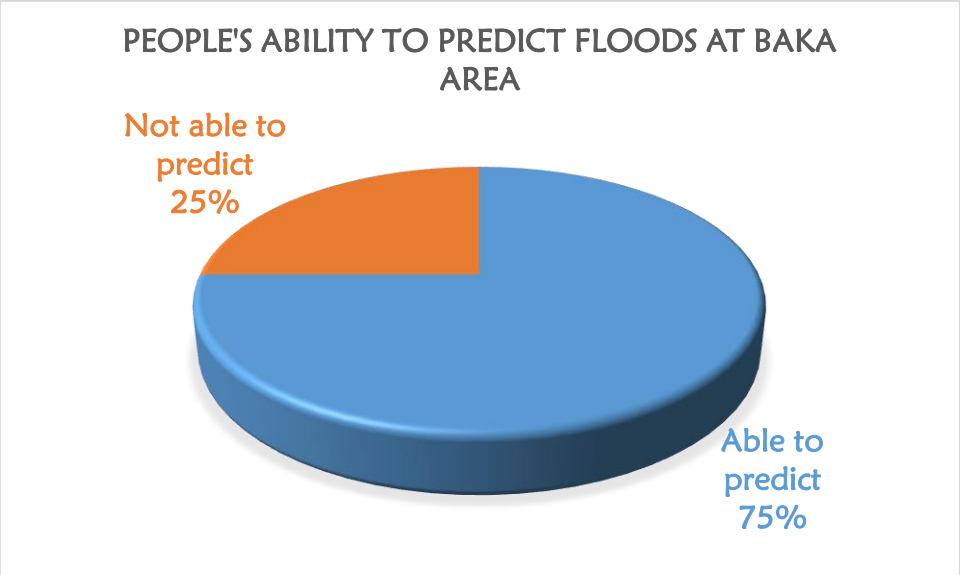


Figure 3: Showing the ability of people in the Baka area to predict floods.

Figure 3 above shows people's ability to predict floods in the Baka area. The researcher found out that 75% of the respondents can predict the pending floods while 25% of the respondents are not able to predict. These people who can predict floods observe different things that direct them e.g. presence of a large number of flogs in the village which has migrated from the river, rise in the water levels in the river (north Rukulu), continuous rainfall, hovering of the big birds in the sky, strange sound from the river, muddy smell of water of the river and presence of dry leaves, mud, and other materials in the river water. This indigenous way of predicting floods is important in helping the community to save lives and properties and also to identify the coping strategies to be employed before flooding which enhances the Disaster Risk Reduction to the community through the construction of structural measures and engagement in non-structural measures which include making sandbanks and giving early warning to warning to all community members respectively. To concur with this, Shaw et al. (2008) pointed out that indigenous

knowledge is the key to the community's coping practices that have helped vibrant communities to survive natural disasters over centuries.

4.2.3. Level of education

As shown from the figure below, the researcher found out that out of 40 respondents, the majority of them attained primary education representing 50% while those that attained no education at all were only representing 12.5%.

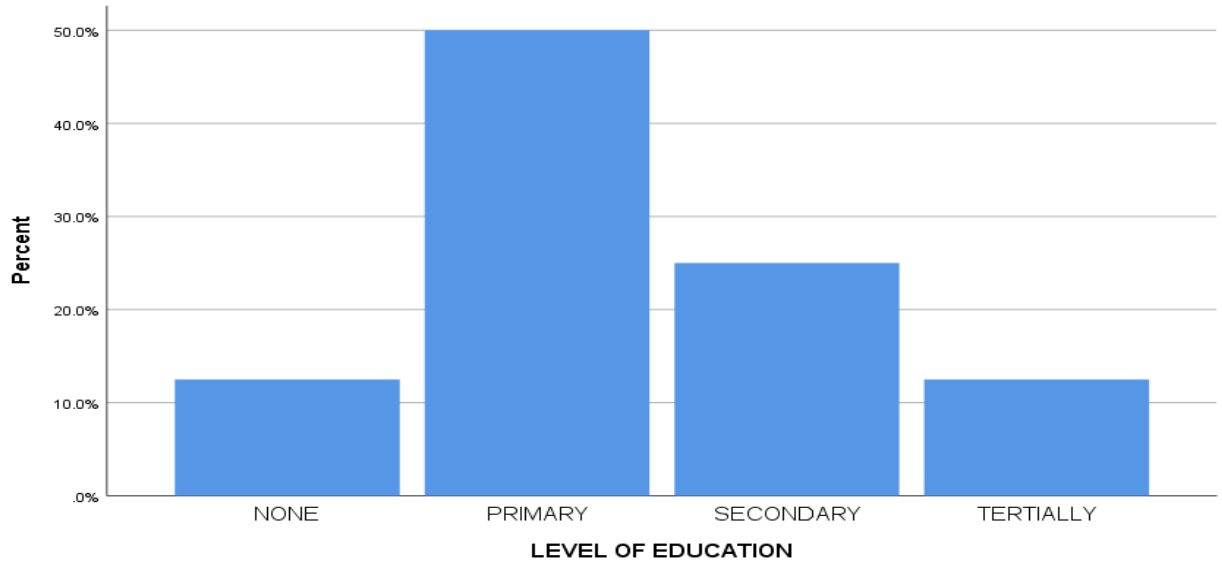


Figure 4: showing the level of education of the respondents in the study area

4.2.4. Livelihood

The research showed that the dominant source of livelihood in the Baka area is crop production (47%), followed by trading (30%) and fishing (13%), see figure 5 below. According to Jere, the Relief and Rehabilitation Officer for Karonga district, the main sources of income for most households was known to be crop production followed by

trading and charcoal burning while the main sources of food were own production of rice, maize, and cassava followed by fishing. The dependence on crop production as the main source of livelihood and food increases exposure to floods which leads to food insecurity. This tells that the Baka area has a deficiency in livelihood options as most of them indicated to have less or no other livelihood apart from farming.

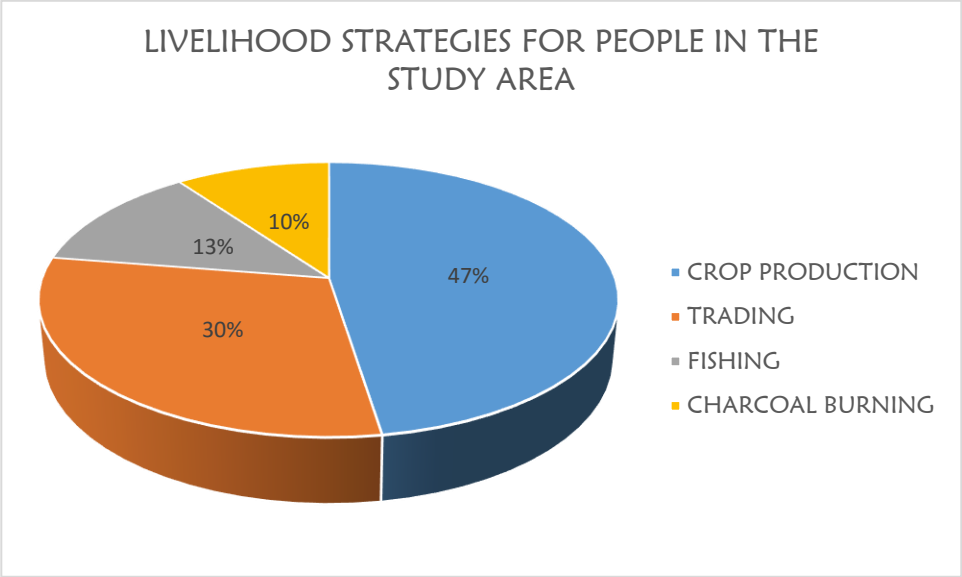


Figure 5: showig the livelihood strategies for people in the study area

The implications are such that the community will have reduced resilience to floods based due to the lack of a wide range of livelihood options.

It was also observed that the marital status of household heads played an important role in determining the livelihood strategy. Those who were married had adversity of livelihood (crop production, trading, fishing, and charcoal burning) as opposed to single divorced, separated, and widowed headed families because of the differences in responsibility for example most married respondents had children who require different support, unlike single respondents who only look after themselves or a few other individuals. See figure 6 below.

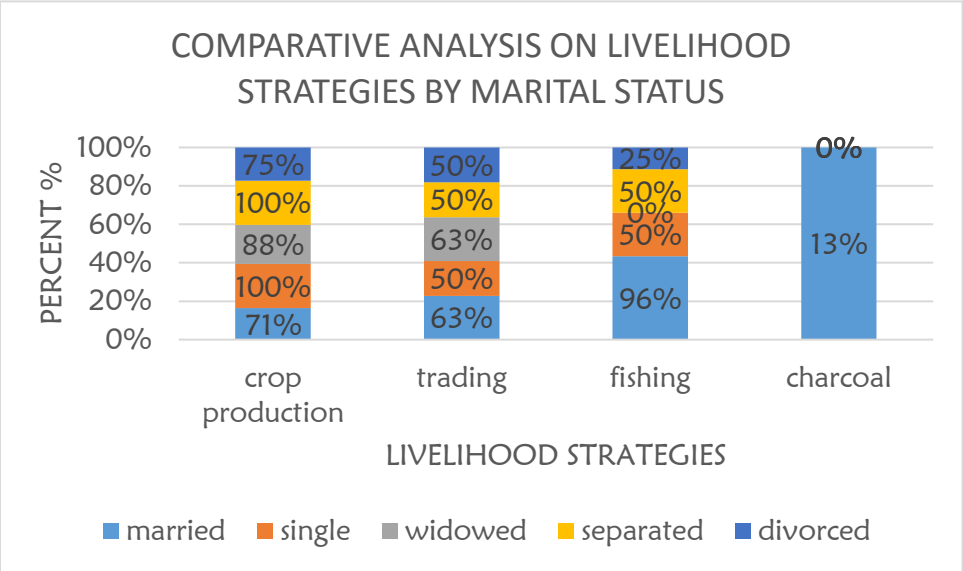


Figure 6: Showing the comparative analysis on livelihood strategies by marital status

Furthermore, the study established that the household with the family size ranging from 5-7 persons had diversity in terms of livelihood options where if they are affected by floods, they will be able to employ alternative livelihood options to mitigate the related impacts of a disaster.

4.3. Human activities that contribute to floods in the Baka area

As stated by Jere, the factors contributing to flooding in the study area are; the geographical terrain of the area, various human activities, and the more water from the upper areas of Chitipa that receive heavy rains. To support Jere, the respondents pointed at some of the specific human activities that contribute to flooding in the area.

Figure 7 below shows the human activities contributing to flooding at Baka area where 50% of the respondents said cultivating along the river banks causes floods at Baka area, 32% of them said it's because of cutting down of trees in the area, and 18% argued by saying the main flood contributing factor in the area is construction in flood-prone areas. The researcher discovered that the Baka area is near the north Rukulu river which makes

the human activities in the figure below more critical in the area. These activities increase the vulnerability of people in the area to flooding. When trees are cut, the ground cover characteristic is altered since vegetation works together with soil to store rainwater and this increases runoff rapidly rather than infiltration in the areas where the vegetation has been cleared due to agricultural activities or construction. This usually leads to the pouring of more water into the streams or rivers which increases the risk of flash or river floods. According to Agone (1995), the development of the flood-prone area for habitation and recreation has been increasing with a corresponding increase in the risk of life and properties due to floods.

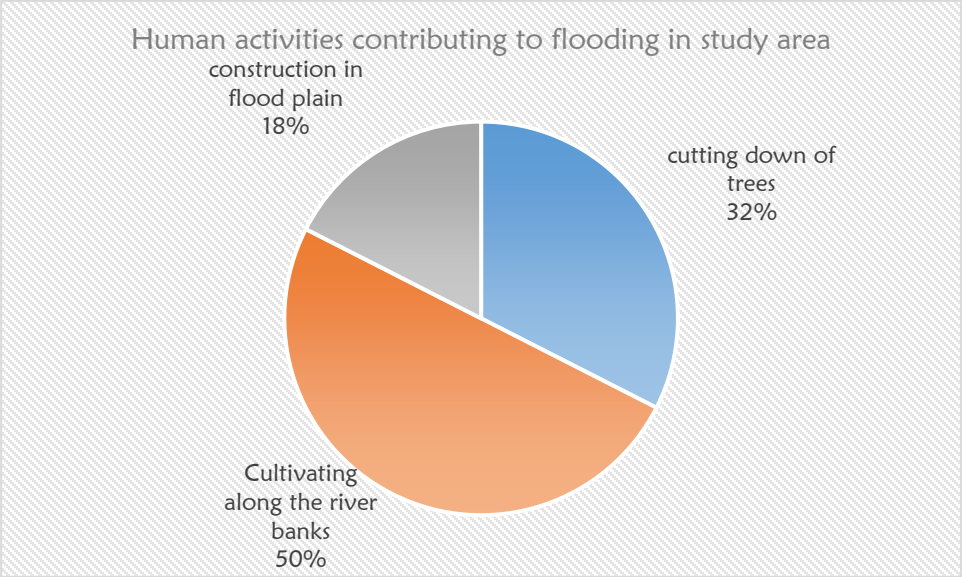


Figure 7: Showing human activities contributing to flooding at Baka area

4.4. Impacts of floods on people living in the Baka area

The impacts of floods in the study area were studied based on the specific sector of concern and these sectors are described below.

4.4.1. Agriculture

In the case of the study area, the research showed that 92% of the respondents directly or indirectly depend on agriculture, and from the findings, it was clearly shown that during flooding the most impacted sector is agriculture. Some of the flood impacts on agriculture are; less return from animal husbandry due to sudden attacks of disease in pre- and post-disaster situations and changes in the cropping pattern due to flooding and inundation which causes farmers not to transplant paddy in time hence delaying the harvesting of paddy. This change in cropping pattern reduces the overall crop yield and it affects the local people negatively since agriculture is the main source of their livelihood pattern hence increasing their vulnerability to flooding impacts. Apart from paddy, Maize, Cassava and Sweet potatoes are also crops damaged by floods in the area.

4.4.2. Education

All sampled household respondents indicated that education facilities exist in the area and about 38% of them, stated that the school infrastructure was damaged during flood events. The study also showed that 53% of the sampled household respondents indicated that the school-going children experienced disruption due to floods. This disruption came due to some of the following reasons; roads impassable (40%), schools and houses submerged (20%). Figure 8 below shows a house submerged in floodwater hence disrupting school-going children from attending school.



Figure 8: Showing houses submerged in floodwater in the Baka area, Manisha village

4.4.3. Housing

The damages caused to houses by floods are more visible in the study area. Most of the damages caused depend on roofing and wall structure and most houses in the study area that collapses during continuous rains their roof are grass thatched and walls made of mud which soak water hence collapsing easily. While thatched houses were severely damaged on the other hand the cemented pillar, brick wall, and concrete houses were observed to be partially damaged from the flood. Figure 8 below shows a house damaged by continuous rains in the study area which lead to floods.



Figure 9: showing a house damaged by flood water in the Baka area, mwanyesha village.

4.4.4. Water and sanitation

The sampled household respondents showed the various type of drinking water sources they had in the area. It was found out that boreholes, protected and unprotected wells and were the most common water sources used for drinking (see in figure 10 below).

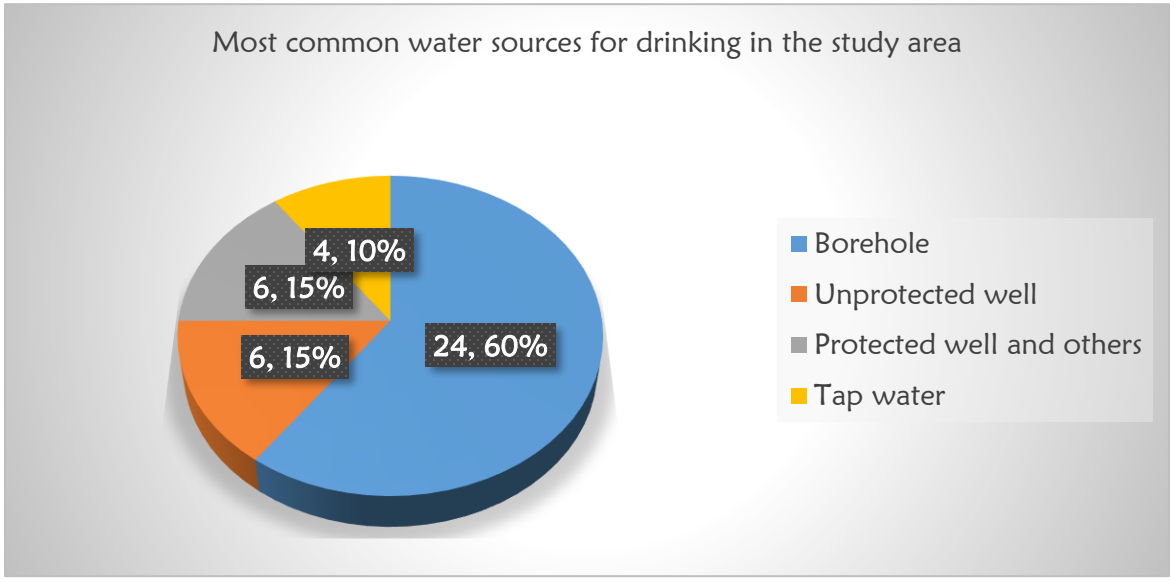


Figure 10: Showing different sources of drinking water in the study area

The findings from the research showed that 60% of the respondents indicated that the main source of drinking water was borehole followed by unprotected well and tap water

at 15% and 10% respectively. Additionally, among the sampled respondents, 67% showed that their common water source of water for drinking was affected by flooding.

In terms of sanitary facilities, 55% showed that they had no sanitary facilities (using bush and river as an alternative). 27% indicated that they had traditional pit latrines as their sanitary facility (see figure 11 below) within their compound and 10% of them had their sanitary facilities damaged by floods. Lastly, the study found out that 38% of the respondent's households usually experience cholera outbreaks, 46% malaria and 27% experienced both as the impacts of floods on the health of people in the study area.

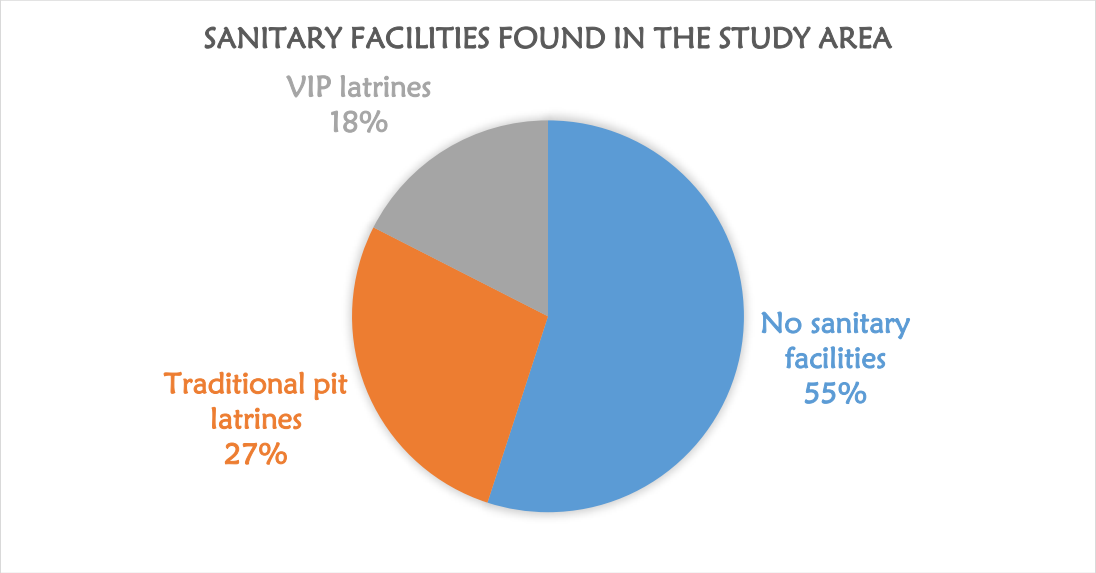


Figure 11: Showing different sanitary facilities used in the study area

4.4.5. Livestock

In the study area, the research shows that most people raise different livestock e.g. goats, sheep, chickens, and cows. Animal husbandry is the second most dominant livelihood in the study area to crop production, therefore, the sweeping of livestock and death by floods and some flood-related diseases had negative impacts on the livelihood of people in the area. This generally increases the vulnerability of people in the area to flood impacts by

destroying or damaging their livelihood patterns. Furthermore, it also becomes difficult to feed animals like cattle, goats, and sheep during the flood because most grazing lands are covered with floodwater leading to a lack of food for animals which further results in animal malnutrition and death.

4.5. Coping strategies employed by people at the Baka area

It was found out that all the respondents which represent 100% managed to mention some of the coping strategies which are applied by the people in the area before, during, and after flooding to achieve DRR in the area. Table 2 below shows coping strategies applied before, during, and after flooding.

Before flooding	During flooding	After flooding
• Cultivating on small portions on uplands • Sensitizing on the flood awareness campaign • Identifying and arranging the evacuation camps • Changing diet • Making sandbanks • Raising the floor of the house • Training people how to get to the evacuation camps during flooding • Making canals	• The rescue program takes place • Evacuation to the camps • Making boats From banana raft platform	• Repairing the damaged houses • Shifting permanently to uplands • Planting new crops • Reconstruction of infrastructure • Practicing small scale farming through irrigation

This research established that the sampled households employed a variety of coping strategies before, during, and after flooding. The most significant coping strategies were changing diet (69%), evacuation to camps (85%), and repairing damaged houses and other infrastructure with support from different stakeholders (90%).

Similarly, research by Mwape (2009), shows that various households in the Sikaunzwe community in Kazungula district (Zambia) employed several coping strategies due to flooding. The most employed strategies were cultivating on small portions on higher grounds (75%), shifting to higher grounds (68%), and making canals (63%). Additionally, coping strategies can also include the actions such as migration from flood-prone areas, flood forecasting, food stockpiling, providing emergency heathy services, flood insurance of crops and animals, and building flood shelters (Ngwira, 2013). It's important to first build on coping strategies which are commonly employed by the community in applying DRR in the area for it helps to address the impacts of floods effectively at the local community level.

4.6. Mitigation measures and factors hindering their implementation

UNISDR (2009) defines mitigation as a range of policies, legislation, and practices that are designed to reduce the effects of hazards in the community. This is important for reducing the impacts of a disaster (DRR). Mitigation measures are classified into two which are structural and non-structural measures.

4.6.1. Mitigation measures

According to the Relief and Rehabilitation Officer for Karonga and the respondents of the study area, the mitigations measures that were identified in the study area are as follows:

Firstly, construction of a dyke. This is a structural measure used for DRR, specifically flood risk reduction. It helps in accommodating rainwater and the water that overflows from the

river e.g. accommodating water that overflows from the north Rukulu river which goes to causes havoc in the study area. The study area lies closer to the flood plain of the north Rukulu river which makes the area vulnerable to flood risk and therefore the construction of a dyke will be useful in reducing the community's vulnerability to flooding.

Another proposed mitigation measure is promoting modern farming methods/ practices. It was found that most people in the area rely heavily on farming as their main most outstanding livelihood strategy. In the study area, people grow crops like rice, bananas, and sweet potatoes for cash and crops like maize for food. Modern farming methods include crop diversification and irrigation practices and all these can help in reducing the community's vulnerability to flooding by ensuring food security in the area.

Furthermore, it was also found that riverbank protection was another mitigation measure. This could be achieved through planting trees or reeds along the river bank and buffer zone. People around the community plant trees for example fruit trees in their dambo but not along the river banks. Planting of trees is important for it helps in binding the flood plain soils together hence resisting overflowing water from the river and this reduces the vulnerability of the people in the area.

Lastly, strengthening the early warning systems is another mitigation measure proposed to be of great significance in the study area. This is the non-structural measure that helps people to be alert of the pending hazard e.g. flood and be able to prepare for it to reduce the impacts of its associated disaster. Early warning systems help the community to put in place all the coping strategies to be done before flooding e.g. making sandbanks, making granaries like houses, and identification and arrangements of evacuation camps.

4.6.2. Factors hindering the implementation of mitigation measures

The investigator found out that people at Baka area have had been told to evacuate permanently from the area to the higher grounds and that they should turn the area into agricultural land and also the portion of land was identified to be used for the construction

of a dyke which was protested against by the villagers since the area was being used for agricultural production and farming being the main livelihood strategy in the area, this gave villagers a reason to be angry toward the proposed development. According to the Relief and Rehabilitation Officer for Karonga, there some factors that hinder the implementation of mitigation measures like evacuation and dyke construction among others, and these are cultural and economic.

4.6.2.1. Cultural factors

It was discovered that there is resistance from the community to leave the flood-prone area because they cannot leave their ancestors land. A few of the respondents said that they were born there, raised there, and have stayed there for over 25 years and they cannot abandon the land because that's where they belong. This clearly shows the dedication of the local people to their culture and others mentioned that they refused to evacuate permanently because they did not want to lose the privilege, they have in the community e.g. chieftainship and land ownership. These strong beliefs and trust in their traditions make it difficult to move to safe places, as a result, the community keeps being exposed to avoidable disaster risks in this case flooding.

4.6.2.2. Economic factors

Apart from cultural factors, economic factors also affect mitigation measures implementation in the study area. The study area is close to Karonga town and this makes their trading activities more effective hence for them to go to other places far from the town they think will hinder their business activities, therefore, making it difficult for them to evacuate. Additionally, people benefit from the privileges which are present in the area and these privileges include, chieftainship where the local people show love and care for their leader by giving them livestock like goats, chickens among others. Furthermore, the land that was identified by the local government for construction of a dyke some villagers

are using it for agricultural activities e.g. people grow crops like rice, maize, and sweet potatoes among others and this proved to be difficult for people to accept as many of the people in the area depend on farming as their main livelihood strategy. A research study by Mwape (2009) discovered that people in the Sikaunzwe community showed a willingness to evacuate only if the relocating should go with the provision of all necessary socio amenities such as schools, hospitals, infrastructure, water, and agricultural support for three years to enable the households to settle.

4.7. Vulnerability causes

There were several causes of vulnerability to flooding at Baka area discovered and amongst them, the ones considered as main factors were proximity to flood-prone areas (55%), lack of alternative livelihood strategies, and poverty (12.5%). The research revealed that the main causes of vulnerability for sampled households were residing in the flood-prone areas and poverty.

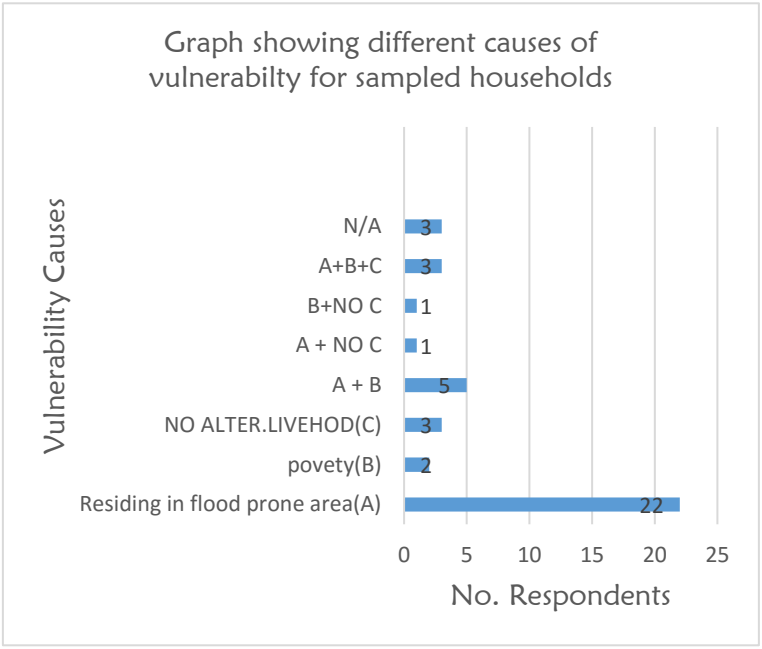


Figure 12: Showing different causes of vulnerability to flooding in the study area

From the research, it was found that the most vulnerable group of people to flooding in the study area were women, children, and the elderly. According to Kutub et al. (2017), women are affected severely by floods and their role is quite negligible in decision making as well as their participation in training related to flood issues. They suffer from physical injuries and are often evicted from their dwelling places due to flooding and they usually find it difficult to have adequate shelter, food, safe water, and fuel for cooking as well as problems in maintaining personal hygiene and sanitation prevent women from performing their usual roles at home. Despite this heavy burden which women bear in extremely difficult circumstances they demonstrate considerable fortitude and ingenuity in their attempt to cope with floods by taking several steps like selling assets, moving toward higher grounds, storing dry food, borrowing money from the bank, other financial institutions or family and friends, collecting safe drinking water and managing households' activities. It was shown in the study area that despite all the adversities, women can cope with the consequences of floods and show their resilience capacity. The major impacts that women face in the study area due to floods are; death caused by drowning, snake bite, water-borne diseases, and diarrhea. Lastly, women have less access to ownership to resources and also less power in the family decision-making process in the study area. Poor making power of women is one of the main reasons for flood vulnerable. Children and elderly people are vulnerable due to their inability to help themselves during flooding or after flooding.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

This chapter presents the conclusion and recommendations that rose from the study. The research aimed at the following questions.

- ✓ What are the causes of persistent flooding in the Baka area?
- ✓ What are the causes of the persistent flooding in the Baka area?
- ✓ What are the impacts of this persistent flooding in the study area?

- ✓ What are the coping mechanisms employed in mitigating the impacts of flooding in the area?
- ✓ What are the factors that hinder the implementation of the coping strategies?

5.1. CONCLUSION

As discussed in this research, it is clear from the study that floods harmed the livelihoods for people in the Baka area and it is evident that there are varying underlying causes of people's vulnerability and some of the causes which were identified by the Baka community were as follows; Proximity to the flood-prone area (55%), residing in the flood-prone area and poverty (12.5%). The study has further demonstrated that the effects of floods in one sector can affect other sectors of society. For example, as discussed under the health impacts of floods on people, the outbreak of disease incidences (malaria and diarrhea) was attributed to the impact of floods on water sources and sanitation facilities. The issue of water contamination of the river at the pick of floods and the handling of water from the borehole increases the health risk.

Furthermore, although no health facility was damaged due to floods, accessibility to health services was a problem due to infrastructure (roads and bridges) where roads were submerged into floodwater and bridges were damaged. In addition, school attendance was disrupted due to impassable roads as discussed under the education section.

From the study, it was clear that households cope differently when affected by floods. The current coping strategies being employed by most households are not very effective. Discussions at community and district levels established that the coping strategies were not sustainable because they had been using them and yet the situation did not seem to improve. The local communities coping capacities should not be underestimated but rather built upon. The focus must be on improving the livelihood conditions of the people.

The communities should be encouraged to build houses using durable materials, residing away from the flood-prone areas as well as practicing afforestation and reforestation to

conserve the environment. Furthermore, the Ministry of Agriculture and Cooperatives should through the Extension Services encourage the communities to increase the area cultivated on the upland to enhance the food security at the household level since people in the study area depend on farming as their main livelihood strategy. Input support programs for vulnerable but viable farmers should be considered.

There is a need to develop better and appropriate measures to prepare and mitigate the effects of floods. Above all, the aim must be to involve all the concerned individuals to enhance communities' resilience to floods.

5.2. RECOMMENDASTIONS

It is therefore relevant in this chapter to highlight some recommendations which, if mainstreamed in policy development as well as projects implementation, possibly will play a significant part in flood risk management. The following considerations are recommended: -

- The policy that encourages communities especially in rural areas to build houses using durable materials and away from flood-prone areas should be strengthened.
- The Ministry of Agriculture should through the village heads and the Area Civil Protection Committee encourage the villagers to increase the area cultivated on the upland to enhance food security at the household level.
- Construction of dams as well as dykes should be considered around the north Rukulu river to trap the excess water. This could be used for irrigation.
- Government and key Stakeholders should engage the communities and local authorities in making them aware of the flood risk given the climate variability.
- Community initiated mitigation measures should be promoted to build community resilience
- In long term, community-based early warning flood systems should be developed

5.3. AREAS OF FURTHER STUDY

A study should be conducted on the health and environmental impacts of floods as well as the economic impacts of floods.

A study should also be done to assess the effectiveness of indigenous coping mechanisms employed in various communities' flood-prone areas.

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APPENDICES

Appendix 1: Key Informant questionnaire

This questionnaire has been developed by Blessings Moyo to obtain data that will help in writing a dissertation for submission in partial fulfillment of the requirements for the award of the Bachelor of Science in Meteorology and Climate Sciences. This study aims to investigate the causes, impacts, and coping strategies for flooding. The data collected will remain confidential and will be used only for the production of the research project.

INSTRUCTIONS:

1. Do not write your name on this questionnaire

2. Tick in the appropriate box for the questions that are demanding that

3. For the questions which require you to explain write-in spaces provided

and Please be direct and to the point.

PART A: BIODATA

1. Position _____

2. Sex M/ F

3. Education qualification _____

4. Work experience _____

PART B: Causes of floods

5. Baka is one of the areas frequently hit by floods in Karonga

Yes /No

6. Why is the Baka area prone to floods? Is it because of:

i. The geographical terrain of the area

ii. Human activities in the area

iii. Other _____

PART C: Coping mechanisms and mitigation measures

7. Have you ever tried to evacuate the people in this area?

_____

8. What factors led to the failure to evacuate them?

_____

_____

_____

_____

_____

9. What coping mechanisms are employed in the event of floods in the area? Specify whether used before, during, or after flooding if possible.

_____

_____

_____

10. What are the mitigations measures that have been put in place to minimize flood impacts in the area?

11. Who are the most vulnerable group to flooding in the area and why them?

_____

_____

END OF QUESTIONS

THANK YOU

DATA COLLECTION QUESTIONNAIRE FOR COMMUNITY

This questionnaire has been developed by the researcher to obtain data to help in writing a dissertation in partial fulfillment of the requirement for the award of the Bachelor of Science in Meteorology and Climate Sciences of Malawi University of Science and Technology. This study aims to find out the causes and impacts of floods in the Baka area. The data collected will be kept confidential and used only for the production of a research project.

INSTRUCTIONS

1. Do not write your name on this questionnaire
2. Choose or tick the appropriate answer for the question that requires you to do so
3. For the questions demanding you to explain, write in the space provided but should be brief and clear

Research Title: Investigating the Causes and Impacts of Persistent Flooding:

A case study of Baka area in Karonga District

T/A : Kyungu

Village :

Questioner Name: Blessings Moyo

Date of Interview:

1. Household Demography

Sex of Household Head	M / F	Age:	Marital Status :

1.1 What is your occupation?_____

1.2 How many are you the in the family?_____

1.2 Total number of children of the household _____

1.3 Total number of school going children of household _____

1.4 Educational qualification of the household head _____

1.5 For how long have you stayed in this area? _____

3. FLOOD IMPACTS

2.1. Housing

2.1.1. Please briefly explain what type of damage happened to your house

_____

_____

2.1.2. What are properties that were damaged during the flood?

_____

3.3. Agriculture/livestock

3.3.1. List main 3 staple crops you grow

3.3.1.1. _____

3.3.1.2. _____

3.3.1.3. _____

3.3.2. What type of damage happened to crops during flood?

_____

3.3.3. Was there any damage caused to your livestock?

_____

3.4. Education

3.4.1. Explain in brief, what type of damage was caused in the education sector during the flood.

_____

_____

3.4.2. What type of disruption (e.g. Exams, class attendance) occurred for school going children in your household experienced due to floods?

_____

_____

3.5. Health

3.5.1. Are there health services in your area?

Yes/ No

3.5.1. What type of health services exist in the area? If the answer is yes from above.

_____

3.5.2. What type of damage was caused during the flood?

_____

3.5.3. Was there any disruption in access to health services during flooding? If yes, specify the disruption caused

_____

3.5.4. Which of the following diseases were experienced by the household members and who got sick?

3.5.5.1. Diarrhea

3.5.5.2. Malaria/Fever

3.5.5.3. Measles

3.5.5.4. Others

Specify _____

3.6. Water and sanitation

3.6.1. What is your common source of drinking water?

3.6.1.1. Borehole

3.6.1.2. Protected well

3.6.1.3. River

3.6.1.4. Others specify_____

3.6.2. Was the source affected by floods?

Yes/ No

3.6.3. What type of sanitary facilities do you have?

3.6.3. Was the sanitary facility affected by the floodwater?

3. Livelihood pattern

3.1. What is the major livelihood pattern of the household?

_____

_____

What was the damage caused to your livelihood?

_____

_____

_____

3. COPING STRATEGIES

3.1 Mention the coping strategies that are used:

1. Before flooding

_____

_____

_____

2. During flooding

_____

_____

_____

3. After flooding

_____

_____

_____

4. ADDITIONAL QUESTIONS

4.2 Who are the most vulnerable group to flooding in your area and why them?

_____

4.3 Are you able to predict a flood likely to happen in your area?

Yes / No

4.3.1 If yes from the question above, what are the signs that you always consider?

_____

_____

_____

4.4 At what time of the year do you receive floods here in the Baka area?

_____

4.5 What do you think can be a reason for your area being prone to floods?

_____

4.6 what do you think should be done by the government and other stakeholders to improve your living conditions by reducing your vulnerability to flooding through increasing your capacity.

_____

END OF QUESTIONS

THANK YOU FOR YOUR TIME!!!!!!!