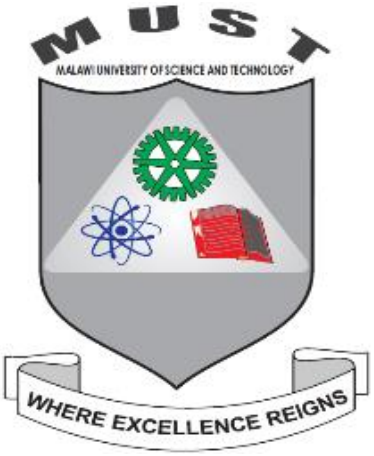


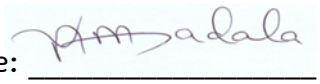
ASSESSING FLOOD RISK KNOWLEDGE AND ADAPTATION CAPACITY OF INDIVIDUALS: The case of Thuchila River at Nkando, Mulanje

[CHARLES BONONGWE]
Thyolo, Malawi

Dissertation submitted to Ndata School of Climate and Earth Sciences of the Malawi University of Science and Technology in partial fulfilment of the requirements for the Bachelor of Science degree in Disaster Risk Management

July, 2021

DISSERTATION APPROVED BY:

Dr V. Msadala Signature: 

ASSESSOR:

Signature: _____

DISCLAIMER

This document describes work undertaken as part of a programme of study at Ndata School of Climate and Earth Sciences of the Malawi University of Science and Technology. All views and opinions expressed therein remain the sole responsibility of the author(s) and do not necessarily represent those of the School.

COPYRIGHT STATEMENT:

This copy of the dissertation has been supplied on condition that anyone who consults it is understood to recognize that its copyright rests with its author and that no quotation from the dissertation and no information derived from it may be published without acknowledgement.

DECLARATION

I hereby declare that all materials and information presented herein are my work and that I have referenced all the work from other studies. I am also aware that plagiarism is not recommended in academic writing.

ABSTRACT

The study aimed at assessing flood risk knowledge and adaptation capacity of individuals at Nkando in Group Village Headman Kalilima. The study used primary data only. A questionnaire was administered to a randomly selected 82 participants as a sample size. Key Informant Interview was done with the group village headman and the chairperson of Village Civil Protection Committee. The data was then entered in Statistical package for Social Sciences (SPSS). A series of independent t-test and spearman's correlation were carried out in the analysis stage of the study. Upon the completion of the data analysis, it was determined that risk knowledge is driven or affected by some social variables in the community. Gender, education, type of residence, length of residence and flood experience were among the factors that were deemed significant in terms of the effect they have on flood risk knowledge. It was also established that risk knowledge does play a part in shaping the adaptation capacity of individuals. Stacks of Sand bags, temporary and permanent relocation were some of the common adaptation measures that the participants undertake. An overall analysis of the mean percentages proved that the level of risk knowledge is low resulting from low levels of disaster risk awareness and low participatory and community centred disaster risk management or reduction activities. Recommendations were made that further studies should prioritize on comprehensive survey methods. Focus groups should be used as they allow individuals to be more flexible and open up to express their knowledge and concerns. A standardized sample size should be a priority to avoid biased results. More variables like amount of individual or household earnings and trust in official sources of flood risk information should be considered in further studies.

ACKNOWLEDGEMENTS

First of all, I would like to thank Almighty God for the gift of life and all that come along with it. For without Him I would not be alive to write this dissertation. Secondly, my warmest gratitude goes to my beloved grandmother. I would not be the person I am today if she had not sacrificed so much more than I could imagine. And also my acknowledgement goes to Dr Eric Lipsky for funding my education, am forever grateful for the unending generosity you have shown to me. This project however, would not be a success without the effort of my supervisor DR Msadala. He has sacrificed his time and knowledge to guide me in any way possible to finish the project, for that am forever grateful.

And my Gratitude goes to MUST Administration for funding and allowing me to conduct this research. And finally my acknowledgements go to my brothers and sisters and all those that have played a part lifting me up to achieve this life's endeavour.

Contents

1. Chapter 1. Introduction 1
   1.1. Background 1
   1.2. Problem statement 2
   1.3. Main and specific objectives 3
   1.4. Research questions 3
   1.5. Significance of the study 3
2. Chapter 2. Literature review 5
   2.1. Introduction 5
   2.1.1. Flood experience and risk knowledge 5
   2.1.2. Risk knowledge and information 6
   2.1.3. Risk knowledge and Social demographics factors 7
   2.1.4. Risk knowledge and Flood risk management 7
   2.1.5. Risk knowledge and adaptation capacity 8
3. Chapter 3. Methodology 9
   3.1. Type of study 9
   3.1.1. Study area 9
   3.1.2. Research design 11
   3.1.3. Sampling and sample size 11
   3.1.4. Data collection and tools 12
   3.1.5. Ethics and professionalism 13
4. Chapter 4. Results and discussion 14
   4.1. Adaptation measures adopted in the community 14
   4.2. Factors affecting risk knowledge 15
   4.3. Relationship between risk knowledge and willingness to adapt 19
5. Chapter 5. Conclusion and recommendation 21
   5.1. Conclusion 21
   5.2. Recommendation 21
   5.2.1. Recommendations for further studies 21
   5.2.2. Policy recommendations 22

ACRONYMS/ABBREVIATIONS

EWS	Early Warning System
KII	Key Informant Interviews
NGOs	Non-Governmental Organisation
VCPC	Village Civil Protection Committee
UNISDR	United Nation Strategy for Disaster Risk Reduction

LIST OF FIGURES

Figure 1. Map showing study area (produced from arc map) 10
Figure 2. Research design flow chart 11

LIST OF TABLES

Table 1: Percentage of participants by gender 13
Table 2: Cross Table showing participants taking adaption measures based of flood experience 14
Table 3: Cross Table showing type of residence and taking adaptation measures 15
Table 4: Showing summary of results from a series of independent t-test 16
Table 5: Summary of correlations between social variables and indicators of risk knowledge 18
Table 6: Summarizes correlations of indicators of risk knowledge and their correlation with willingness to adopt adaptation measures..... 19

1. CHAPTER 1. INTRODUCTION

1.1. Background

Flooding is one of the leading disasters across the globe. Based on its frequency, flooding account for one-third of all-natural disasters (UNISDR 2005). Many countries worldwide, experience and suffer some kind of floods and Malawi is no exception. Flooding, as is the case in Malawi and many other countries, has become a perennial problem with a wide range of damages and losses every time taking back years of development and costing both the government and non-governmental organizations millions of dollars for reconstruction and recovery activities (Okaka & Odhiambo, 2019).

Based on the study area, mainly the overflowing of the river, Thuchila, leads to flooding. This has been the case due to changes in land use activities that interfere with its channel like cultivation and encroachment along its banks and deforestation at the upper course of the river leading to excessive surface runoff and erosion hence silting the river. Floods have never been occurring extensively at Nkando until recently. Since 2015, floods now are occurring almost every year .The unwillingness of individuals to relocate from the risk places, poor preparedness and inappropriate behaviours and inadequate adoption of adaptation measures have left them being environmental refugees as they are accommodated in camps every time a flood occurs since their houses are washed away or filled with floodwaters.

Preparing and responding to a disaster requires coordinated actions among all stakeholders involved including communities at risk. One aspect that plays a role in the preparedness, response and adoption of adaptation measures is the risk knowledge that the vulnerable people possess. Risk knowledge is defined as people's perception of how well they know a risk, and of how well a risk is known to science (Mondino et al., 2020). In simple terms it refers to community awareness of disaster risks (Odiase et al., 2014). It encompasses but not limited to the awareness of the magnitude of risks, local hazards, and exposure, susceptibility and the capacity of elements at risk of local hazards (World Meteorological Organisation 2020). The first

priority of the Sendai Framework For Disaster Risk Reduction encourages an understanding of disaster risks at all levels (Sendai Framework for DisasterRisk Reduction 2015 - 2030 1, 2015) and as well enhancing disaster preparedness which is charged through broad spectrum of risk knowledge. And the predecessor of the Sendai framework, Hyogo framework, emphasizes that communities and local authorities should be empowered to manage and reduce disaster risk by having access to the necessary information, resources and authority to implement actions for disaster risk reduction (Strategy, 2015). This means that risk knowledge be enhanced at local and community levels to for resilience.
Malawi disaster risk management policy (NDRMP, 2015) acknowledges the extent how lack of information and risk knowledge among local people have exacerbated the levels of vulnerability across all at risk communities. And also emphasizes how this limited risk knowledge at community level affect safety and resilience of these at risk communities. While structural measures can do their part to protect vulnerable communities from flooding, risk knowledge among vulnerable people unveils the reactions and even their perception of flood disaster in their social and scientific context (Bird, 2009; Landstro et al., 2011; Mondino et al., 2020; Wang et al., 2018).

1.2. Problem statement

Floods continue to be one kind of a disaster claiming millions of dollars for relief, reconstruction and recovery activities every year in the aftermath. It is fascinating to note that every time a flood occurs at the same place still cause huge damages and losses. Despite the meteorological department in Malawi issues flood warnings in most of the flood pone areas following a predicted amount of rainfall, there is an increased apathy in spite of vulnerable people to respond effectively to the warnings and as well finding ways to adapt. The apathy still avails in unwillingness of the vulnerable to adapt. So, this informs the need to assess the knowledge of the vulnerable people towards flood risk which is an important element in early warning system and an important aspect in flood risk management. It is therefore, as well, the need to solicit information on extent to flood risk knowledge among the communities at risk, access to weather-related information, media through which the

information is accessed. So the question remains, what knowledge do the vulnerable people have on flood risk?

1.3. Main and specific objectives

The study aimed at assessing flood risk knowledge and adaptation capacity of individuals at Nkando in Mulanje. The other specific objectives are;

- To assess prevailing adaptation measures being adopted in the community
- To identify key factors driving risk knowledge in the study area
- To examine the relationship between flood risk knowledge and willingness to adapt

1.4. Research questions

1. What are the adaptation measures that are adopted in the community?
2. To what extent is flood risk knowledge among the community at risk?
3. Does flood risk knowledge strengthens adaptation capacity of the community at risk?

1.5. Significance of the study

Natural hazards are inevitable. The impacts resulting from natural hazards at space in time are exacerbated by human actions. Understanding vulnerable people's knowledge and their capacities on flood risk will help the government and non-governmental organizations in developing communication strategies that will effectively enable the engagement of communities and societies to deal with the perennial problem of flooding. The development of an action plan for adaptation and mitigation strategies and measures of the recurrent flooding is also based on the knowledge that the vulnerable people have in regard to flood risk (Bodoque et al., 2018; Kundzewicz et al., 2010; Mashi et al., 2020; Verde et al., 2019). Issues to deal with risk reduction particularly early warning system is built on risk knowledge. It is the knowledge of risk among individuals that ensure effective response behaviour during flood events. And adopting adaptation measures depends on sound

knowledge of risks. So this study will unravel those factors that enhance and sharpens flood risk knowledge among vulnerable and at risk communities, so much attention can be paid to them to build safe and resilient communities through increased adoption of adaptation measures. It is then risk knowledge that enables the community build the adaptive response to a potential disaster, in this case flood (Odiase et al., 2014).

2. CHAPTER 2. LITERATURE REVIEW

2.1. Introduction

Risk knowledge is one of the four elements of early warning system under disaster risk management. Basically, this is only known to experts or officials available in this field that it is to the vulnerable communities. It is the very same reason that even though warnings maybe issued with even a higher lead time, the reactions and behaviours that the vulnerable people show still leave some fatalities. In this paper, risk knowledge is defined, however, as people's perception of how well they know a risk, and of how well a risk is known to science (Mondino et al., 2020). It is then assumed that those that having knowledge of the risks they face in their daily lives was do something in working to manage some the risks even with little resources available.

This then, brings the issue of adaptation of such risks, in particular flood risks. Adaptation refers to the adjustment in natural or human systems, processes, measures in structural or non- structural in order to reduce or offset the potential damages or losses associated with hazards resulting from climate change (Younus & Harvey, 2013).

This chapter, however, reviews literature on the related topic and present the summary of the various studies conducted.

2.1.1. Flood experience and risk knowledge

Theoretically, flood experience can be a very important influence in shaping flood risk knowledge among those living in flood prone areas. Direct flood experience over a number of times brings the concept of familiarity of the flood hazard especially to those affected. So to be able to having the knowledge of the flood risks is mainly charged through being familiar with the hazard (Mondino et al., 2020).

In this case, familiarity refers to the extent to which people have become accustomed to a risk. Here, the concept of familiarity brings together knowledge and experience: a person who experienced a number of floods can get accustomed to the event and his/her risk knowledge about it may increase (Mondino et al., 2020; Weichselgartner & Pigeon, 2015). Most studies, however, revealed that the flood experience can increase flood risk perception and people with recent flood experience would acquire good knowledge of flood and all related risks associated with it and do well in adopting adaptation measures (Wang et al., 2018).

2.1.2. Risk knowledge and information

Often flood risk knowledge among local and vulnerable people is gained from direct experiences of flooding events gathered in the past as mentioned above. That is flooding experience awakens people to realize the risks that they are in or they are exposed to. However, acquiring historical, physical, geographical, and many other types of information, in turn, can contribute to individual flood risk knowledge. Thus, knowledge is certainly not only a product of direct flood experience but also information shared among vulnerable people (Mondino et al., 2020).

Sources of information can be e.g., books, hazard and risk assessments, maps, urban plans, and historical archives for those that are able to read (Mondino et al., 2020; Weichselgartner & Pigeon, 2015). Moreover, information can be provided through different channels, including official sources (e.g., public authorities through radios, televisions etc.), through awareness campaigns related to flooding and informal networks (e.g., friends, neighbours and family members). Personal research is also an increasingly relevant source of information, especially through internet/on-line searches (Mondino et al., 2020). Formal education from primary school to University is also a critical source of knowledge about flood risk and natural hazards more in general especially if the curriculum has such components of hazards and disasters (Mondino et al., 2020; Weichselgartner & Pigeon, 2015).

(Weichselgartner & Pigeon, 2015) clearly emphasize the dynamic character of knowledge, which is built through social interactions that shape the data, information, and facts that each individual is processing. In fact, the creation of knowledge does not happen merely by providing new data or information, but

rather when such information is processed. That is information was lead people to familiarize a flood hazard to some extent. So it is worth mentioning that, the familiarity however, brings together knowledge and experience: a person who experienced a number of floods can get accustomed to the event and his/her self-assessed knowledge about it may increase (Odiase et al., 2014; Tuladhar et al., 2015; Weichselgartner & Pigeon, 2015).

2.1.3. Risk knowledge and Social demographics factors

Risk knowledge is not only influenced by direct experience of a flood event but also some underlying factors. Zaalberg et al, 2009 argued that the socio-demographic characteristics of an individual have an influence in shaping knowledge of risk. Flood risk knowledge together with the demographic factors of an individual plays a major role in the adoption of adaptation measures both short and long term which was help in the diminishing of flood risk in the long run (Kreibich, 2011). These factors include age, gender, education level, income and home ownership. The study of (Mondino et al., 2020) found out that women tend to have higher knowledge of flood risk which complements the results of another study from Hwang, 2008 and that they are the ones willing to adopt adaptation measures (Tuladhar et al., 2015). Education as one another socio-demographic factor, in a flood risk management point of view, can also have significance in shaping flood risk knowledge among local people. However, studies conducted under this topic, did not operationalize or pay much attention to this factor as indicated in the studies of (Mondino et al., 2020; Tuladhar et al., 2015; Weichselgartner & Pigeon, 2015). Level of income may have varied correlations, positive or negative, in shaping risk knowledge mainly where cultural constraints overlap. (Mondino et al., 2020) found that level of income has a positive effect on risk knowledge where those with a higher level of income may build their homes away from rivers or strong buildings near rivers with the idea of trying to reduce risk (Mondino et al., 2020)

2.1.4. Risk knowledge and Flood risk management

Flood risk management present a framework that aims at reducing human and economic losses caused by flooding through adaptation processes. It involves

understanding where flooding may occur, actions to reduce the possibility of flooding and adjusting to the risks and acting to reduce the impacts of flooding (Risk, 2015). It is a product of having an understanding of the risks. Risk knowledge, for flooding, is geared in achieving an effective flood risk management. Early warning system is embedded in this flood risk management. The performance of the EWS rests on sound risk knowledge by those households and communities at risk (Mikeka et al., 2017). So it is then worth mentioning that risk knowledge should not be only attributed to experts or professionals in that field or sector but rather be known even to those individuals, households and communities that are at risk. This is not only important in early warning system but rather flood risk management as a whole.

2.1.5. Risk knowledge and adaptation capacity

Adaptation, the adjustment in natural or human systems, processes, measures in structural or non- structural in order to reduce or offset the potential damages or losses associated with hazards resulting from climate change requires certain levels of capacities. To be able to adapt to risk conditions is charged in using available resources and skills. But then the adjustment comes with being familiar with the risks. This is where the concept of risk knowledge comes in play. (Tuladhar et al., 2015) argued that risk knowledge though it is mainly mentioned in EWS, necessitate the capacity of people to adapt to climatic hazards. They even further mentioned, that is of more important to then assess the level of risk knowledge among at risk communities and identify factors that may enhance risk knowledge.

However, many studies focused on perception of risk among people, which is mainly based on social aspects in different communities. Risk knowledge however, is based on science (Tuladhar et al., 2015; Weichselgartner & Pigeon, 2015). The study conducted by (Odiase et al., 2014) found out that risk knowledge has a powerful influence in adaptation capacity of at risk communities. They concluded that risk knowledge provides the needed impetus for community resilience and a psychological boost to community participation in DRR and mitigation.

3. CHAPTER 3. METHODOLOGY

3.1. Type of study

This research is a descriptive type of study. Which aims at describing what is there, where data is collected at specific point in time and do not extend into the future . And this study used both qualitative and quantitative research methodologies to accomplish the aforementioned objectives. The qualitative method was used to analyse data mainly collected through interviews. The quantitative method was used to statistically analyse data collected using the questionnaire.

3.1.1. Study area

Nkando community is located in Mulanje at 15.9166^{0}S and 35.3593^{0}E latitude and longitude respectively. It a big trading surrounded by villages. To the east of this trading there runs Thuchila River. Thuchila River extends from Mulanje Mountain which receives more rainfall contributing to high amount water volume in the river. Till recently, 2015, this area has considered flood prone than it was twenty years ago. Climate change that leads to unprecedented amount of precipitation and also human activities pertaining to land use have exacerbate flood risk.

During rainy season the river burst into its banks causing widespread damage to properties and even fatalities. The flooding is mainly triggered at the confluence of Thuchila and Nkondez Rivers. Nearly 70% of the households that are living within 500m from the river have suffered flooding some twice or three times with 2015 and 2019 floods being the devastating ones. Despite the fact that stakeholders have constructed a dyke to protect the community from flooding, still water do overflow the dyke though without much destruction than when there was no dyke. The study area is shown in Figure 1 below.

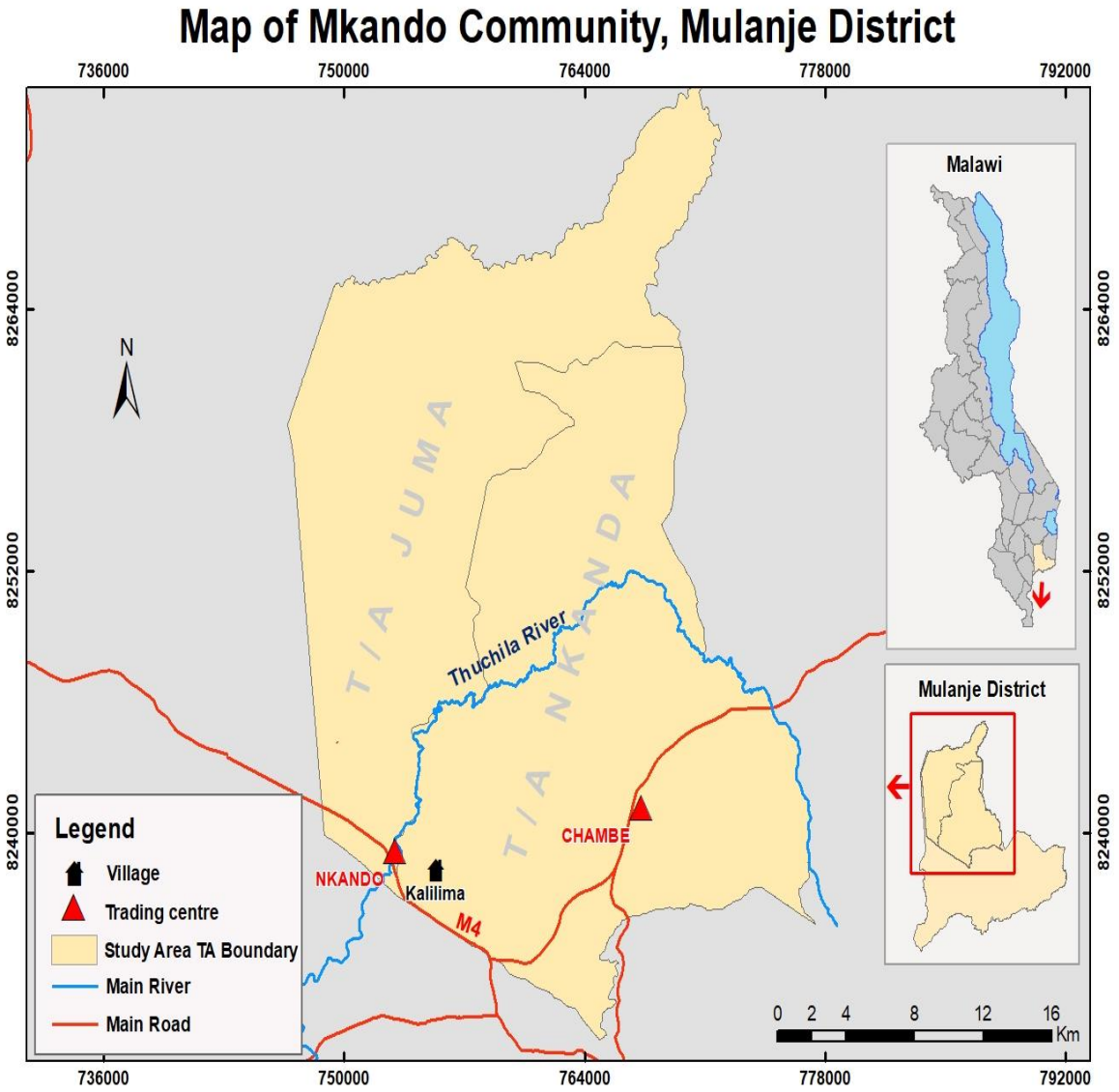


Figure 1. Map showing study area (produced from arc map)

3.1.2. Research design

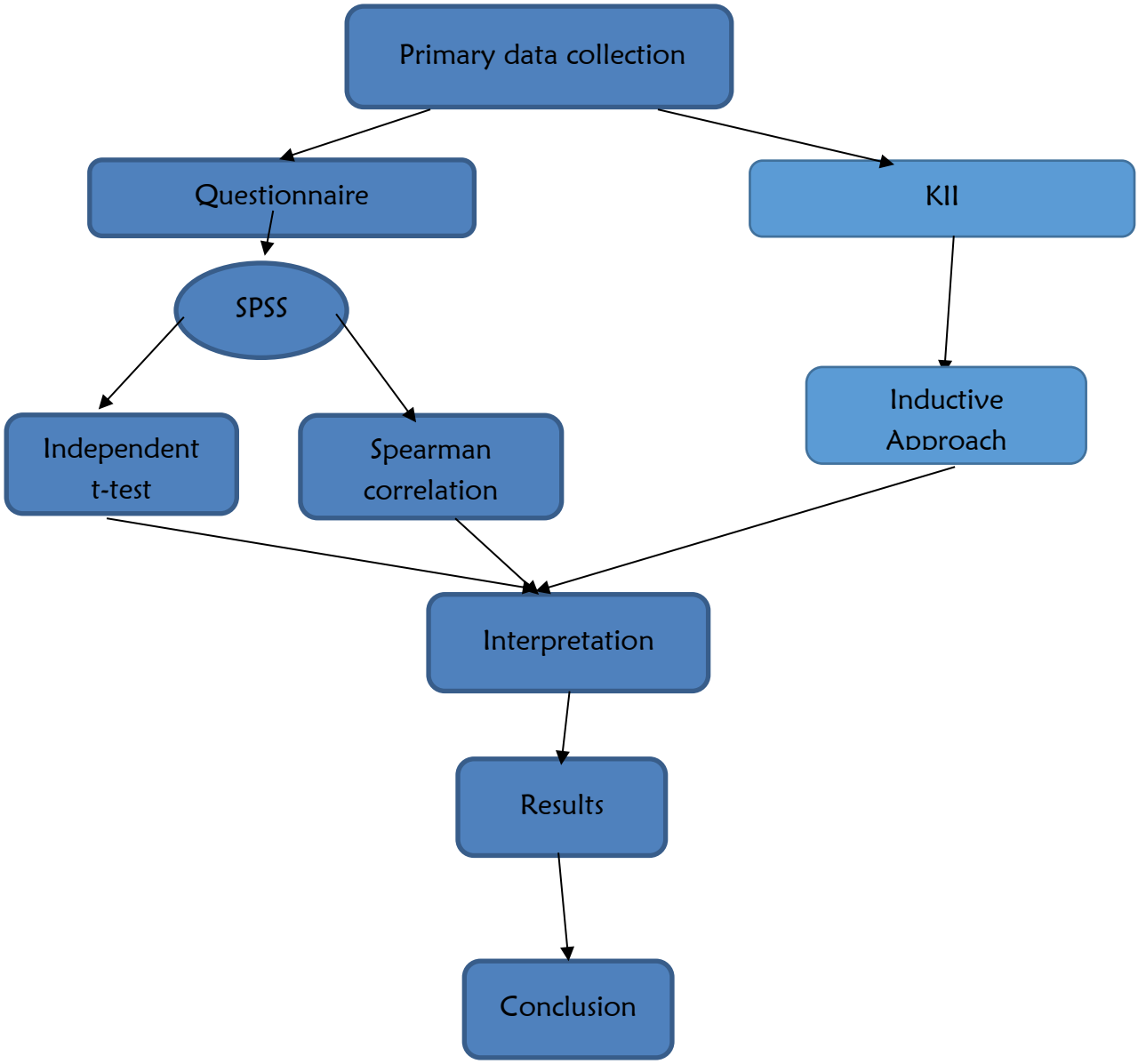


Figure 2. Research design flow chart

3.1.3. Sampling and sample size

The target population was randomly selected. This is a sampling method where participants are given equal chances to participate in responding to the questionnaire. Multi-stage sampling method was adopted to select Key informant interviewees. The

sample size was determined using the following proportions of participants' formula (Daniel, 1999):

$$n = \frac{Z^2(P)\ (1-P)}{e^2}$$

Where **n** is sample size, **Z** is value of normally distributed standard variate which takes different values with a given confidence interval value. **P** is the proportion of the participants with the attribute under study out of the total population in the study area. So the value 0.5 was used for **P** since the proportion was unknown. And **he** is the allowable error or the desired level of accuracy. So in this study, the formula was calibrated at a 90% confidence interval, which gives 1.645 as the value of **Z** and an allowable error of 9.1%. Using the formula, the sample size (n) was found to be 82. The study took 89.1% accuracy that the calculated sample size was the true representation of the population size. So this study used a sample size of 82. Calculations are shown in **Appendix A**

3.1.4. Data collection and tools

The study adopted a theoretical framework based on a psychometric paradigm which attempts to quantify individuals' risk knowledge through a survey questionnaire and interviews. It is a tool developed for natural hazard research (Fuchs et al., 2017; Taylor et al., 2014; Verde et al., 2019). So, this study used methods to collect data that is a questionnaire and key informant interviews (KII). The questionnaire consisted of four sections. Demographic characteristics of the individuals, flood related knowledge which focuses on whether individuals experienced flooding, flood disaster adaptation and flood disaster awareness as shown in **appendix B**. It consisted 40 questions combined in all the four sections. The questionnaire was administered to randomly selected individuals at the age range of 18 years and above. Only one individual per household was interviewed to avoid duplicates. The interview was done with the Group Village Headman (GVH) Kalilima and the chairman of a Village Civil Protection Committee (VCPC).

The Table below gives summary of percentage of male and female participants in the questionnaire;

Table 1: Percentage of participants by gender

	Frequency	Percent
Male	46	56.1
Female	36	43.9
Total	82	100.0

Of all the participants, 56% were males and 44% female**s.**

3.1.5. Ethics and professionalism

Prior to data collection, a letter of reference was obtained from MUSTREC to guarantee data collection. The village headman was first briefed to guarantee permission to address the questionnaire. All participants signed an agreement to participate of their own will. All measures were put in place to avoid violating rights of the participants.

4. CHAPTER 4. RESULTS AND DISCUSSION

4.1. Adaptation measures adopted in the community

When asked if the participants know about flood adaptation measures 67.1% responded that they know some while the remaining 32.9% responded that they do not know. Of the 67.1%, 26.8% mentioned that they do take some adaptation measures mainly sand bagging and some mentioned to have planted trees along the river especially in their small farms though without much successful. The lower proportion on number of participants adopting adaptation measures may be a result of low awareness raising to communities at risk of flooding. The Disaster Preparedness and Relief Act of 1991 (DPR Act 1991) stipulates the roles and responsibilities of Area Civil Protection Committee and Village Civil Protection Committee among which community sensitization on disaster risk management and mobilizing community participation aim at helping at risk communities to familiarize disaster risks and most importantly to have better risk knowledge of hazards. Lack of community awareness and sensitization renders ignorance of vulnerable people to adopt adaptation measures. The chairman of the VCPC acknowledges the inactive state of the committee such that they never even once had a meeting with the community members. Even the committee members of the VCPC had never been trained, from local government officials or Organizations, on what they should do in all phases of the disaster risk management circle regarding flooding. Those that experienced flooding (35.3%) as shown in **Table 2** and also that live in their permanent houses (35.5%), as shown in **Table 3** were the ones more interested in adopting adaptation measures and were more keen to relocate to safer areas should they get access to such lands.

Table 2: Cross Table showing participants taking adaption measures based of flood experience

		Taking adaptation measures		
		yes	no	total
Flood experience	yes	18	33	51
	no	4	27	31

	total	22	60	82

Table 3: Cross Table showing type of residence and taking adaptation measures

Type of residence		**Taking adaptation measures**		
		yes	no	total
	Permanent	22	40	62
	rented	0	20	20
	total	22	60	82

4.2. Factors affecting risk knowledge

Risk knowledge is geared to increase the awareness of the scientific aspect of the risks that the at risk communities face. The participants were asked if they are aware of available hazard maps, vulnerability and capacity assessment. The results show that many of the individuals 67% do not know of available hazard maps. The participants were as well asked on the access to information on flood risk in their area. The results show that 81% of the participants get information from radios and neighbours. Now to further understand variables that affect risk knowledge among individuals, a series of independent t-test were carried out to depict important factors that may possibly affect flood risk knowledge. The study used gender, education level and type of house the participants reside as grouping variables against awareness of available hazard maps and access to information mainly on warnings of an impending flood disaster. On the level of access to information on impending flood hazards, there was a statistical significance of the mean differences between males and females with a ($p=0.050$) as shown in the **Table 4** below. In this case males were found to have more access to hazard information from officials' sources than women. In this context, females do not have enough access to information which practically may hinder them possessing risk knowledge since information is a pillar in acquiring risk knowledge. So the unequal access of such information among males and females further limits women's participation in disaster risk activities which may in turn increases their vulnerability to flooding. However, there was no statistical significance

on mean gender differences in terms of being aware of available flood hazard maps in the area (p=0.740). In terms of type of residence, there was a statistical significance in mean differences for permanent and rented residences. As shown in the Table **below 4**, those living in rented houses proved to have more access to information than those living in their permanent houses (p=0.000). The same was also confirmed in the level of awareness of available flood hazard maps. This may be attributed to the fact that most of the rented residences work at nearby schools and healthy clinic in the area which arguably offers them more access to information and even knowledge on the available hazard maps. The same outcome was found in a previous study conducted by Neef et al (2020). Education level of the participants were found to have an effect on access to information and aware of available of hazard maps with a (p=0.013) and (p=0.000) respectively as indicated in Table **4 below.** The participants that are educated at least up to secondary or tertiary level were proved to have access to information and aware of hazard maps than the uneducated or those who reached primary level. Previous studies conducted on the same, Finnis et al. (2010), Roder et al. (2016) and Neef et al (2020) have also supported the relationship between education and the determinants of risk knowledge in communities.

Table 4: Showing summary of results from a series of independent t-test

Testing variable	**Grouping variable**					
	Female		**Male**			
	Mean	SD	Mean	SD	t	Sig(2-tailed)
Access to information	1.24	0.413	1.44	0.504	-1.986	0.050
Aware of flood hazard maps	1.17	0.378	1.20	0.401	0.333	0.740

	Permanent		Rented			
	Mean	SD	Mean	SD	t	Sig(2-tailed)
Access to information	1.240	0.432	1.000	000	4.412	0.000
Aware of flood hazard maps	1.42	0.497	1.05	0.224	4.584	0.000
	Educated		**Not educated**			
	Mean	SD	Mean	SD	t	Sig(2-tailed)
Access to information	1.330	0.488	1.000	0.000	-2.646	0.019
Aware of flood hazard maps	1.670	0.488	1.07	0.258	-4.209	0.000

A spearman's coefficient correlation analysis was carried out to depict the level of risk attached to flooding in the participant's homes and the community as a whole in regard to social variables which are gender, age, level of education, flood experience, and length of residency. **Table 5**: shows some social variables tested against the level of threat that individuals attach from flooding to their home and community. Education was found significant with a positive correlation r=0.488 and r=0.474 (p=0.01 two-tailed) for home and community respectively. It then describes the fact that those that are educated have knowledge on existing flood risks to their homes and community as a whole. So education does affect risk knowledge. This result supports the conclusion that education does have an effect on disaster preparedness which is related to flood risk knowledge (Mondino et al., 2020; Odiase et al., 2014; Tuladhar et al., 2015) . There was a negative correlation between length of residence with r= -0.226 (p=0.05 two-tailed) and risk attached to flooding in the community. This implies that staying long in a community, individuals are has

adapted to the situation therefore their threat perception regarding flood risk decreases as they may find ways to live in that condition. The same outcome was found by Mondino et al., 2020). Those who once experienced flooding also showed a significance with r= 0.700 for home and r=0.729 ($p<0.01$, two-tailed). This implies that having experienced some flooding develops and/or strengthens some level of awareness of the flood risks to one's home and the community. The results obtained from the studies conducted by (Mondino et al., 2020 and Odiase et al., 2014) support the conclusion that flood experience explicitly influences risk knowledge . In this regard, risk knowledge is mainly driven by level of education, the length an individual has been staying in the community and most importantly flood experience significantly contribute to person's risk knowledge from flooding as supported with literature.

Table 5: Summary of correlations between social variables and indicators of risk knowledge

Independent variables	Dependent variables		
	Threat at home	Threat to community	Aware of hazard maps
Gender	-0.018	-0.021	0.217
Age	0.100	0.193	-0.193
Education	0.488**	0.474**	0.048**
Length of residence	-0.174	-0.226*	0.074
Flood experience	0.700**	0.729**	0.042

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.3. Relationship between risk knowledge and willingness to adapt

Risk knowledge, if well enhanced in vulnerable and at risk communities, does help motivate people, prioritize early warning needs and as well may guide disaster risk reductions activities at community level (UNISDR, 2006). In this context, to determine the relation between risk knowledge and willingness to adapt, a spearman's correlation was carried out. The relationship was analysed using independent variables: flood experience, gender, aware of existing flood hazard maps, knowledge on flood damage at household level, knowledge on risk exposure of the community with willingness to personally adopt adaptation measures as summarized in **Table 6** below. Willingness to adapt depends on certain indicators of risk knowledge. The influence of such indicators to a greater extent renders a change in how individuals conceptualize disaster risks and veers in a better understanding and therefore develops and strengthens willingness of people to adapt.

Table 6: Summarizes correlations of indicators of risk knowledge and their correlation with willingness to adopt adaptation measures.

Independent variables	Dependent variable
	Willingness to adapt
Flood experience	0.245*
Knowledge on flood community threat	0.191
Knowledge on home damage	0.228*
Aware of hazard maps	0.307**
Information from local government/NGOs	0.374**

Information from media	0.215

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

As shown in the Table, those individuals who experienced flooding created a positive correlation between having risk knowledge and willingness to adopt adaptation measures r=0.245 (p<0.05, two-tailed). Similarly, knowledge on home damage from flooding was also found significant r=0.228 (p<0.05, two-tailed), those aware of existing flood hazard map r=0.307 (p<0.01, two-tailed) and information from official sources like local government and NGOs r=0.374 (p<0.01, two-tailed). So, this explains that at 99% confidence interval, willingness to adapt is directly related with awareness of available hazard maps and getting information from NGOs and at 95% confidence interval, willingness to adapt is directly related to flood experience and knowledge on home damage from floods. In this context, however, out of the six indicators adopted in this study four of them proved to have a positive relationship in enhancing the willingness of individuals to adopt adaptation measures. However, there was no significant relationship on having knowledge on risk threat from flooding to the community and getting information from media and neighbours with the willingness to adapt.

4.4. Study limitations

The study acknowledges the following limitations

i. Subjective responses from participants
ii. Smaller sample size
iii. Limited funding

5. CHAPTER 5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The study assessed the level of flood risk knowledge of individuals and their capacity to adapt from the flood risks. It was noted that a smaller number of participants do take some adaptation measures though with little or without guide from the local authorities. Stacks of Sand bags, temporary and permanent relocation were some of the common adaptation measures that the participants undertake. It was then concluded that the level of risk knowledge is low. Many of the participants were not really aware of flood hazard risks of their community. This then significantly entails that more need to be done boost the level of risk knowledge of the local people in vulnerable communities. The unveiling of the low risk knowledge is as a result of low awareness levels of disaster related issues, the inactiveness of the VCPC and low participatory and community centred disaster risk management activities

It was also determined that risk knowledge is affected or influenced by certain factors as they impact the indicators of the risk knowledge. The significant factors that were determined are; gender, education, flood experience, length of residence in the community and type of residence whether permanent or rented.

It was also concluded that risk knowledge however influences the willingness of individuals in the community to adapt to the flood risks. In this case, risk knowledge strengthens the adaptation capacity of individuals which will further their resilience towards flooding.

5.2. Recommendation

5.2.1. Recommendations for further studies

The following outlines the points that should be considered for further studies

a) Focus groups should be used as they allow individuals to be more flexible and open up to express their knowledge and concerns.
b) A standardized sample size should be a priority to avoid biased results.

c) More variables like amount of individual or household earnings and trust in official sources of flood risk information should be considered
d) Cultural overlap with flood risk should comprehensively investigated

5.2.2. Policy recommendations

Below are highlighted policy consideration that should be applied for effective flood risk reduction and management for strong resilience.

a) All disaster risk related activities must be participatory in nature to bring culture of safety and risk knowledge
b) All maps related to disasters should be made available in an easy to use format to the at risk communities to enhance risk knowledge among the vulnerable people
c) The Village Civil Protection Committees should be made active and properly trained as they have a great role in boosting disaster risk awareness among the vulnerable

REFERENCES

Bird, D. K. (2009). *The use of questionnaires for acquiring information on public perception of natural hazards and risk mitigation – a review of current knowledge and practice*. 1307–1325.

Bodoque, J. M., Amerigo, M., García, J. A., & Olcina, J. (2018). Enhancing flash flood risk perception and awareness of mitigation actions through risk communication: A pre-post survey design. *Journal of Hydrology*. https://doi.org/10.1016/j.jhydrol.2018.11.007

Daniel. w. w. (1999). Biostatisticts: *A Foundation for Analysis in the Health sciences.* 7th Edition. New York: John Wiley & sons

Fuchs, S., Karagiorgos, K., Kitikidou, K., Maris, F., Paparrizos, S., & Thaler, T. (2017). Flood risk perception and adaptation capacity: A contribution to the socio-hydrology debate. *Hydrology and Earth System Sciences*, *21*(6), 3183–3198. https://doi.org/10.5194/hess-21-3183-2017

Kreibich, H. (2011). *Do perceptions of climate change influence precautionary measures ?* https://doi.org/10.1108/17568691111129011

Kundzewicz, Z. W., Lugeri, N., Dankers, R., Hirabayashi, Y., Döll, P., Pińskwar, I., Dysarz, T., Hochrainer, S., & Matczak, P. (2010). Assessing river flood risk and adaptation in Europe-review of projections for the future. *Mitigation and Adaptation Strategies for Global Change*, *15*(7), 641–656. https://doi.org/10.1007/s11027-010-9213-6

Landstro, C., Ward, N., & Bradley, S. (2011). *Coproducing flood risk knowledge : redistributing expertise in critical ` participatory modelling '. 43*(2006), 1617–1634. https://doi.org/10.1068/a43482

Mashi, S. A., Inkani, A. I., Obaro, O., & Asanarimam, A. S. (2020). Community perception, response and adaptation strategies towards flood risk in a traditional African city. In *Natural Hazards* (Issue 0123456789). Springer Netherlands. https://doi.org/10.1007/s11069-020-04052-2

Mondino, E., Scolobig, A., Borga, M., & Baldassarre, G. Di. (2020). *water The Role of Experience and Di ff erent Sources of Knowledge in Shaping Flood Risk Awareness*.

Odiase, O., Wilkinson, S., Neef, A., Zealand, N., & Zealand, N. (2014). *Risk of a disaster : Risk knowledge , interpretation and resilience*. 1–9.

Okaka, F. O., & Odhiambo, B. D. O. (2019). Households' perception of flood risk and health impact of exposure to flooding in flood-prone informal settlements in the coastal city of Mombasa. In *International Journal of Climate Change Strategies and Management* (Vol. 11, Issue 4, pp. 592–606). https://doi.org/10.1108/IJCCSM-03-2018-0026

Risk, L. F. (2015). *Local Flood Risk Management Strategy March*. *March*.

Sendai Framework for Disaster Risk Reduction 2015 - 2030 1. (2015).

Strategy, I. (2015). *Hyogo Framework for Action 2005-2015 : *. January 2005*.

Taylor, A. L., Dessai, S., & Bruine de Bruin, W. (2014). Public perception of climate risk and adaptation in the UK: A review of the literature. *Climate Risk Management*, *4*, 1–16. https://doi.org/10.1016/j.crm.2014.09.001

Tuladhar, G., Yatabe, R., Dahal, R. K., & Bhandary, N. P. (2015). *Disaster risk reduction knowledge of local people in Nepal*. https://doi.org/10.1186/s40677-014-0011-4

Verde, S. V. C., Martins, B., & Lourenço, L. (2019). *Flash Flood Risk Perception by the Population of*. 1–14.

Wang, Z., Wang, H., Huang, J., Kang, J., & Han, D. (2018). *Analysis of the Public Flood Risk Perception in a Flood-Prone City : The Case of Jingdezhen City*. *c*. https://doi.org/10.3390/w10111577

Weichselgartner, J., & Pigeon, P. (2015). The Role of Knowledge in Disaster Risk Reduction The Role of Knowledge in Disaster Risk Reduction. *International Journal of Disaster Risk Science*, *6*(2), 107–116. https://doi.org/10.1007/s13753-015-0052-7

Younus, M. A. F., & Harvey, N. (2013). Community-based flood vulnerability and adaptation assessment: A case study from bangladesh. *Journal of Environmental Assessment Policy and Management*, *15*(3). https://doi.org/10.1142/S1464333213500105

APPENDICES

Appendix A: calculation of sample size

$$n = \frac{Z^2(P)\ (1-P)}{e^2}$$

$$n = \frac{(1.645)\text{^}2\ (0.5)\ (1-0.5)}{(0.091)\text{^}2}$$

$$n = 82$$

Appendix B

FLOOD RISK KNOWLEDGE AND ADAPTATION CAPACITY QUESTIONNAIRE

This questionnaire is presented to you to fill on all given gaps on flood risk knowledge and adaptation capacity. Your feedback will be very help as it will help developing risk effective communication strategies to strengthen social resilience. The results will be treated with utmost confidentiality and used solely for the purpose of this study.

However, participating in this study is free of will. That is, you can choose to participate or you may not. No one including the researcher will question your choice. Should you choose to participate, please answer the questions honestly for the outcome of this study will depend on your honest answers. Tick in the boxes provided and explain where appropriate in the given spaces.

Should anything, related to how this study is being conducted, intimidate or provoke you in anyway, please feel free to report your concerns to my supervisor Dr. V. Msadala on **+265 991 015 161** or you can email through vmsadala@must.ac.mw.

If you may have any question regarding this study, please feel free to contact the researcher on **+265 884 064 747/+265 992 965 815** or email through drm-018-17@must.ac.mw/charl.bononge@gmail.com.

Sign of Researcher _____ Date_____

Sign of participant_____ Date_____

SECTION A. DEMOGRAPHIC CHARACTERISTICS

Gender: Male ☐ Female ☐

Age:

1	What is your level of education?	None ☐ Primary ☐ Secondary ☐ Tertiary ☐
2	What is the type of housing you are residing?	Rented ☐ Permanent ☐
3	What is your source of income?	Employed ☐ small business ☐ farming ☐ Unemployed ☐

SECTION B FLOOD RELATED KNOWLEDGE

1	To your knowledge, what do you think are the possible causes of floods in the area?	Deforestation ☐ Unpredictable natural event ☐ Divine punishment ☐ Natures vengeance ☐ Climate change ☐ Planning policies ☐ I don't know ☐
2	Do you think floods can be prevented?	yes ☐ No ☐ I don't know ☐ If yes, how _____ _____ _____
3	How do you perceive damage to which your house is exposed?	Very High ☐ High ☐ Medium ☐ Low ☐
4	Do you see any possibilities that you may play a role in influencing the occurrence of the flood hazard?	Yes ☐ No ☐ If yes, how?

		_____ _____
5	Is flood hazard fatal?	Strongly agree ☐ Agree ☐ Not Agree ☐ Do not know ☐
6	How do you classify the frequency of flood events in this area?	Very High ☐ High ☐ Low ☐ Very low ☐ Do not know ☐
7	Is the occurrence of flood events predictable to you?	Yes ☐ No ☐ If yes, how? _____ _____ _____
8	Do you perceive the occurrence of flood events to increase or decrease in the future?	Increase ☐ Decrease ☐ Do not know ☐ Increase or decrease, why? _____ _____ _____
9	Does the occurrence of floods evoke emotion of fear?	Yes ☐ No ☐ If yes to what extent?

		Very high ☐ High ☐ Low ☐ very low ☐
10	How do you rate the exposure of the community to flood?	Very High ☐ High ☐ Low ☐ Very low ☐
11	How do you classify number of victims in flood crisis situation in the area?	Very High ☐ High ☐ Low ☐ Very low ☐ Do not know ☐

SECTION C. FLOOD DISASTER ADAPTATION

1	Are you aware of the shelter areas and open space in case of flooding?	Yes ☐ No ☐
2	Do you get any information about flood adaptation from local government or NGOs?	Yes ☐ No ☐
3	Do you know the life evacuation system in the locality?	Yes ☐ No ☐
4	Do you personally take any adaptation measures for flooding?	Yes ☐ No ☐ if yes, give examples _____ _____ _____ If no, why? _____ _____

SECTION D. FLOOD DISASTER AWARENESS

1	How do you get information on the impending flood related disaster?	Radios ☐ Television ☐ Newspaper ☐ Neighbours ☐ Others specify _____
2	Have you ever attended any flood awareness campaign in the area?	Yes ☐ No ☐
3	Are you aware of the flood mitigation and adaptation measures?	Yes ☐ No ☐
4	Are you aware of any evacuation centre during flooding?	Yes ☐ No ☐