ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR ENVIRONMENT AND DEVELOPMENT

FLOOD RISK MANAGEMENT PRACTICE AND ITS EFFECTIVENESS IN ADDIS ABABA: CASE STUDY OF AKAKI KALITY SUB- CITY

BY

ADDISALEM FETENE

A THESIS SUBMITTED TO

CENTER FOR ENVIRONMENT AND DEVELOPMENT

ADDIS ABABA UNIVERSITY
ADDIS ABABA, ETHIOPIA
OCTOBER 2021

ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR ENVIRONMENTAL AND SUSTAINABLE DEVELOPMENT

FLOOD RISK MANAGEMENT SYSTEM AND ITS EFFECTIVENESS IN ADDIS ABABA: CASE STUDY OF AKAKI KALITY SUB CITY

BY
ADDISALEM FETENE

ADVISOR: TAMIRAT TEFERA (PH.D.)

M.A. THESIS SUBMITTED TO
CENTER FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ART IN ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

OCTOBER 2021
ADDIS ABABA, ETHIOPIA

DECLARATION

I, the undersigned declare that this thesis **"Flood Risk Management Practice and Its Effectiveness in Addis Ababa: Case Study of Akaki Kality Sub City"** is my original work. It has not been submitted for a degree in any other universities and all the materials used in this study have been duly acknowledged.

Signature _____ Date _____

Addisalem Fetene Legese

This research project has been submitted with my authority as the university Advisor;

Signature _____ Date _____

Tamirat Tefera (Ph.D.)

Addis Ababa University

School of Graduate Studies

This is to certify that the thesis prepared by Addisalem Fetene, entitled "Flood Risk Management System and Its Effectiveness In Addis Ababa: Case Study Of Akaki Kality Sub City" and submitted in partial fulfilment of the requirement for the degree of master of art in Environment and Development complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

Internal Examiner _____Signature _____ Date _____

External Examiner _____ Signature _____ Date _____

Advisor _____ Signature _____ Date _____

ABSTRACT

This study aims to assess the effectiveness of the flood risk management system in Addis Ababa, particularly focusing on Akaki Kality Sub City. To archive, this objective descriptive case study and mixed approach are employed to gather data. Semi-structured interviews, observation, and household surveys are deployed to collect data.138 experts and 46 household samples are drawn randomly. The qualitative approach was used in order to gain a deep understanding of flood risk management: its practices, systems, and collaboration among institutions to reduce flood hazards. Five interviewees were interviewed until the point of saturation. Directors, coordinators, team leaders, and experts from AADRMC, NDRMC, and Akaki Kality DRM bureau were interviewed since they have adequate knowledge about the issue. Semi-structured KII and document review were data instruments employed for data collection. The quantitative approach was used to incorporate various technical methods including GIS technologies. Surveys were carried out from both experts and households. This is because it is more effective to look at the views of the community and experts to find out what flood management looks like. The study has the following major findings: first, the flood hazard map of the sub-city indicates that around 91% of the total area of Akaki Sub-city is very high to moderate level of flood hazards and all 11 Woredas of the Akaki Sub City are vulnerable for floods. Second, there is evidence that the flood hazard mitigation and preparedness stage still have many problems. As a result, floods are occurring frequently in Addis Ababa city. The flood risk management practice is moderately effective. There is an effective emergency response and has some improvement on an early warning. Thirdly, there is a lack of FRM mainstreaming in the institution's plan and day-to-day activities. Addis Ababa Disaster Risk Management Commission does not have the legal power to enforce other institutions to work collaboratively with them. Fourth, there is also no entity and a separate policy for flood risk management. The study recommends that flood risk management systems should focus on improving activities under prevention and mitigation cycles to decrease flood hazards. Flood risk management activities should be taken into account to enhance the role of institutions in FRM in Addis Ababa and adopt FRM laws that enforce other institutions to do their responsibilities by taking into account flood hazard mitigations.

Keywords: *flood risk, Flood Risk Management practices, institutional collaboration, challenges*

ACKNOWLEDGEMENT

I am using this opportunity to express my deepest unrestrained gratitude to everyone who supported me throughout this research paper. I am grateful to my GOD who have been helping me and guiding me. Next, I am deeply indebted to my whole family that has been providing me remarkable support in everything. I also would like to extend my gratitude to my advisor Dr. Tamirat Tefera for his direction and guidance provided to me to complete this work. Besides, may my heartily thanks go to the ESDS MA program Coordinator, Dr. Shimelis Damene (Ph.D.), for his motivations and supports to make me succeed in my paper work. I am also grateful to those who had helped me and who had willingly participated in my research work. Finally, I heartily give my special gratitude to my friends who had been beside me with their encouragements and support till the accomplishment of my study.

Table of Contents

List of Figures

List of Tables

List of Appendixes

Acronyms

AADRMC	Addis Ababa Disaster Risk Management Commission
CBDRM	Community-Based Disaster Risk Management
DRM	Disaster Risk Management
DRMFSS	Disaster Risk Management and Food Security Sector
DRR	Disaster Risk Reduction
ECA	Economic Commission of Africa
ERCS	Ethiopian Red Cross Society
FAO	Food and Agriculture Organization
FEMA	Federal Emergency Management Agency
FRM	Flood Risk Management
GII	Geospatial Information Institute
GIS	Geographic Information System
HHP	Health Policy Project
HOA	Horn of Africa
HRD	Human Resource Development
IPCC	Intergovernmental Panel on Climate Change
LULC	Land Use Land Cover
MoA	Ministry of Agriculture
MoWIE	Ministry of Water Irrigation and Electricity
MoH	Ministry of Health
MRSC	Municipal Research and Services Center
NDRMC	National Disaster Risk Management Commission
NGO	Non-Governmental Organizations
NMA	National Meteorology Agency

NPSDRM	National Policy and Strategy on Disaster Risk Management
SPSS	Statistically Package for Social Science
SNNPR	Southern Nations, Nationalities, and People's Region
UN	United Nations
UNDP	United Nation Development Program
UNDDR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNFAO	United Nation Food and Agriculture Organization
UNGA	United Nations General Assembly
UNOCHA	United Nation Office for Coordination of Humanitarian Affairs
UNISDR	United Nations International Strategy for Disaster Reduction
WB	World Bank
WHO	World Health Organization
WMO	World Meteorological Organization

CHAPTER ONE: INTRODUCTION

1.1. Background to the Study

Natural disaster risks like flood, drought, volcanic eruptions, landslides, fire, and earthquake are increasing and hit every part of the globe, causing deaths and destructions. Those disaster risks are causes for an uncountable suffering to the millions of people throughout the world (Jateni, 2018). Since 1970, natural disaster risks have impacted more than 5 billion people worldwide, with financial losses of over US$ 1 trillion (Centre for Research on Epidemiology of Disasters, 2011).

The prejudice and complexity of disaster risk is much higher in developing countries than developed countries. Africa is a well-known continent by its adverse disaster risk profiles in which large-scale disasters are increasing and contributed to complex circumstances (UNOCHA, 2011). The African food security is threatened by the most prevalent and damaging hazards like drought, floods (World Bank, 2015), food security concerns (Boyd et al., 2013, Niang et al., 2014), and lack of sanitation and access to drinking water, heat waves, growing storm strength and frequency (IPCC, 2012) and cyclones (ECA, 2015).

Ethiopia is one of the most disaster risk -prone countries in Africa, and in the Horn of Africa as well, due to its vulnerability to climate change impacts and the fact that the majority of its people depend on crop farming, which is highly vulnerable to weather variability (Tesfa et al., 2014). Flood, drought, human and livestock disease, crop pest, fire (Haileyesus, 2016), volcano's (Selamawit, 2018), and internal conflicts are among the most common disasters (HRD, 2018). From time to time, these are becoming more common in the country.

Flooding is one of the most frequent environmental crises and devastating natural risk events to Ethiopia, with the highest impacts occurring in the northern and eastern regions of the country. Flooding poses high risk to the lowland, highland, and urban areas, with an estimated 250,000 people were affected per year by floods. In the lowland part the country, large-scale river flood is the most frequent and common. Whereas flash floods occurring in highland areas particularly in the Rift Valley urban areas of the Awash River basin. Addis Ababa experiencing annual floods along streams descending from nearby hills (Selamawit, 2018). According to ERCS (2006), heavy rains across the region cause for more flooding in various parts of the country, including Addis Ababa.

Addis Ababa is vulnerable to both riverine and flash floods because of severe climatic events and upper catchment activities; and this vulnerability is worsened by a weak drainage system, rapid housing growth along riverbanks, and the use of inadequate building materials (World Bank, 2015). The appearance and duration of floods in Addis Ababa seems to be to be rising over time. Consequently flooding continues as to be a source of concern in Addis Ababa, mainly to who live along river courses.

Flooding is a wreaking havoc to the city by destroying lives, cause for livelihood lost and by exhausting environmental resources. Due to rapid urbanization and population growth, pro poor peoples forced to live in flood-prone areas and it increases the number of vulnerabilities. Moreover, the city's inadequate drainage systems, frequent rains and rise in impervious area in urban areas creates more surface runoff, and the situation will worsen as poor people settle in flood-prone areas like riverine and low-lying floodplains (G. McGranahan *et al.*, 2007).

As Addis Ababa Disaster Risk Management Commission (AADRMC) mention by their report the consequence of global climate change and local environmental pressures, the occurrence and frequency of flood hazards, as well as the severity of damage, are rising over time in Addis Ababa.

According to the Addis Ababa City Resilience Project Office, a report by the Addis Ababa Disaster Risk Management Commission (AADRMC) reported that 121,000 homes in Addis, including 1,000 government and private institutions are constructed in flood-prone areas. For decades, landslides, pollution, and a lack of development have plagued the identified areas. The 3-year AANDRMC annual performance reports shows that 83 flood hazards are registered in three years and it cause for six peoples death with 7,617,100 financial losses.

To this effect, each government organization has taken steps to mitigate flooding hazard that have and massive effect on the economy and the livelihood of society (Shimels, 2013). For this reason, Ethiopia has adopted some instruments that demonstrate the national and regional level of disaster risk management mainstreaming and implementation. These instruments are aimed at decreasing harms of disasters occurring in the country. However, there are barriers such as lack of institutional capacities, week collaboration among institutions and inadequate coordination for the proper implementation of DRM mechanisms (ECA, 2015). To overcome this it is important to identify disaster risk management focal points for strengthening institutional alignment across government agencies and international donors (Sumedh, 2013).

Additionally, disasters are wicked challenges that one single entity cannot fix on its own (Weber and Khademian 2008). Collaboration between local, regional, and state actors is needed for effective FRM (Twigg, 2004). It requires recognizing interdependencies among various entities, at various levels, and across various sectors (McEntire 2007). So to attain a common understanding of FRM, to explain the root causes, to agree on the need for a multi-sector approach to solve the problem and to review the range of strategies proposed for its solution in Ethiopia; it is important to get the full picture of different perceptions of the problem (Neely et al., 2017).

In general, the effect of flooding hazards is linked to numerous external factors, such as the lack of proper mitigation, lack of accountability, financial and human capacity limitations, and flood analysis, which are exacerbating the flooding problem in Addis Ababa City. Indeed, this is closely linked to the study of the effectiveness of the FRM practices in terms of flood hazard management and scientific analysis of the current state of floods at a particular site, including all of its characteristics and flow patterns. This study takes into account the effectiveness of the FRM activities in reducing flood risk in Akaki Kality Sub City, Addis Ababa.

1.2. Statement of the Problem

The flood risk management system practice in a stable community integrates an efficient hazard mitigation structure with a well-functioning and inclusive risk preparedness and emergency response process. Such kind of system and good structure is done by creating an integrated citywide risk assessment and by developing recovery plan from anticipated shocks. In a resilient city, flood risk management is incorporated into all city planning processes, including construction, land use, socioeconomic, and sectoral plans (World Bank, 2015).

Addis Ababa is rapidly expanding beyond its legal and municipal limits, wreaking havoc on the city's socioeconomic conditions and physical climate (UNEP, 2014). The climate in Addis Ababa is expected to become more venerable in terms of precipitation and temperature. This would most likely result in a wide range of hazards in the city like flooding and landslides. Additionally, Addis Ababa's geographic location and topographic features, combined with the city's current drainage, road, and sewerage systems, expose the city to street and riverine flooding, as well as landslides (World Bank, 2015). According to a UNEP study from 2014, heavy rainfall, steep slopes, mountain deforestation, and the building of

houses and other constructions along riverbanks are the key causes of flooding in Addis Ababa city. During the heavy rainstorm strike in the upper basin, the middle and lower areas of the city has affected by flash flooding which is major repercussions for homes, public institutions, transportation, and market places (Selamawit, 2018). This makes the Akaki Kality sub-city area to be more vulnerable to flooding. Inadequate urban drainage schemes in Addis Ababa worsen flooding risk. Runoff waters flows in sewage pipes and discharged into surrounding streams and rivers. However, the urban storm water drainage system is reduced due to debris and sands clogging pipes and street inlets (Wondimu and Alfakih, 1998).
An illegal settlement around riverbanks is one of the major issues that exacerbate the effects of flooding in Addis Ababa city from time to time (Selamawit, 2018). The 2015 World Bank report shows that the seasonal flooding and poor drainage systems overflow are more dangerous for informal settlements along riverbanks. Around 5% of the city's population are thought to be at risk of flooding, with two-thirds of them living in basic mud and wood structures that are highly vulnerable to flooding. In addition to physical harm, these events have causes for epidemics in the city (World Bank, 2015). One of the major concerns that exacerbate flooding in Addis Ababa is the land use change in the nearby upland catchments, as is the lack of adequate and organized watershed management practices in these catchment areas (Selamawit, 2018).

Since Addis Ababa is among the flooded cities in the country, it needs an effective flood risk management system at all government administrative platforms. However, flood risk management capability of Addis Ababa city is seriously lacking, of institution capacity, infrastructure, and financial resources. As the World Bank report descriptions the Addis Ababa city is at a nascent stage in prevention, mitigation, preparedness, response, and recovery of disaster risk management cycles. The report mentions that the lack of early warning systems, emergency response plans, and political attention to hazards is a major responsibility that needs to be resolved.

Collaboration between local, regional, and state actors is needed for effective DRM system (Twigg, 2004). According to some sources, collaboration among institutions is weak. Most flood management operations in Addis Ababa are ad hoc because there is no contingency plan in place and no early warning system to enter communities (World Bank, 2015). There is no structured, systematic, or proper data collection method. There is a lack of converting aggregated data in to more user-friendly format, and making it available to all stakeholders, including communities. There is little evidence that communities and other municipal

agencies have been consulted on flood management, drainage, and fire prevention investments in Addis Ababa. Individual agencies with limited or no consultation mostly drive these investments.

Melis Nigatu, 2020 on his research paper mentioned that, there has been no study and even less articles writing on urban disaster management except for water pollution. Despite the fact that Addis Ababa is one of Africa's fastest growing cities; home for an estimated 25% of Ethiopia's urban population; and more over the city is highly vulnerable to various hazards such as floods, urban fires, and earthquakes, but the research conducted in the region is solely focused on water pollution.

As a result, spending more effort by just focusing on problems like pollutions and flood risk assessment may not have significant solutions and result, unless proper attention is given to strengthen Flood Risk Management systems to decrease the impacts. This is therefore the study emphasizes the effectiveness of flood risk management system and evaluating the institutional collaboration in flooding management. Awareness, rules, codes, and other policy initiatives are worthless without successful implementation (Amendola et al., 2008).

Furthermore, it is reported that the flood risk in the city has increased because of its implementation failure. The explanation for this is the city's risk mitigation, disaster preparedness, and resilience is all dependent on the city government's position and performance (Ethinay and Egbu, 2018). This is therefore, the effectiveness of FRM practice on flooding hazard and integration of institutions participating in FRM were explored in this study to fill the gap.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of the study is to assess the effectiveness of flood risk management activities to reduce flood risk factors in Addis Ababa, with a particular focus on households living along Akaki Kality Sub city.

1.3.2. Specific Objectives

The study has the following specific objectives to:

- identify flood hazards of Akaki Kality by using GIS
- examine the practice of flood risk management in the study area
- assess the practice of institutional collaboration to manage flooding in the study area

1.4. Research Questions

This research intended to address the following questions, which are derived from the research objectives mentioned above.

1. What are the flood hazard areas in the Akaki Kality?
2. What seems to be the practice of FRM during the preparedness, recovery, and mitigation phases?
3. What seems the practice of collaborative management of flood management in Addis Ababa?

1.5. Significance of the Study

This study fills the gap with literature in an area of effectiveness of flood risk management in Addis Ababa. The outcome of the study expected to make a modest contribution to policy analysis and collaboration strategies. Researchers, policy-makers, government bodies, development agents and humanitarian partners may learn lessons from this research regarding the effectiveness of flood risk management practices, DRM and mitigation in Addis Ababa. It gives some insight to institutional collaboration towards FRM by showing the way that solves the existing problems.

1.6. Scope and limitation of the Study

Having objective of studying the effectiveness of flood risk management activities, the spatial scope of the study is delimited to the boundary of the Addis Ababa city, woreda 03 of Akaki Kality sub city. Besides, the study covers the time period between 2020 and 2021. The thematic scope of the study is flood affected households and experts who are working in the DRM organizations in Addis Ababa.

In the process of conducting this research, the researcher encountered challenges such as time and budget constraints, lack of similar works done (inefficient information), and unwillingness of few staffs to cooperate for interview, provision of inaccurate information and reluctant to provide interview were some of the limitations that the researcher faced during this particular work.

.

CHAPTER TWO: LITERATURE REVIEW

Introduction

This chapter presents the relevant theoretical framework of the study by explaining major factors determinate in the study and explores the related empirical studies from different sources related with the effectiveness of flood risk management systems in Addis Ababa with focuses on Akaki Kality Sub City. The first section includes a description of disaster risk as well as an introduction to disaster risks in Ethiopia, as well as a brief discussion of flood disaster risk in Ethiopia, as well as the causes and consequences of flooding. After that, the concept of flooding, causes and consequences of flooding, the concept of disaster risk management and disaster risk management institutions in Addis Ababa were defined. The second sections examine the empirical literature review and the conceptual framework of interest to the topic.

2.1. The Concept of Disaster Risk

A disaster is "*an event concentrated in time and space,'* according to Fritz (1961: 655), *in which a society or one of its subdivisions undergoes physical harm and social disruption, so that all or some essential functions of society or subdivision are impaired.*" Van Wassenhove (2006) describes the disaster as: The term disaster generally refers to a disruption that affects a system physically (natural versus technological or Man-made).

Natural disasters occur primarily due to geological, atmospheric or hydrological origins like droughts, earthquakes, floods, hurricanes, wildfires, landslides (Prasad & Francescutti, 2017. The consequences of these events are more devastating for more vulnerable a communities. In our continent, approximately 90,000 people were died and around 160 million peoples were affected every year because of natural disasters (WHO, 2019).

Human-made disasters are triggered by careless or accidental human acts (US Legal, 2019). It includes an aspect of a human's conscious or unconscious actions or the failure of a mechanism developed by man. Natural disasters can be caused by man-made disasters (e.g. the Fukushima 2011 nuclear accident caused by a tsunami) as part of a chain reaction (World Nuclear Association, 2018).

Disaster Risk

Many considerations play a part in the genesis of a Disaster. It takes more than a threat to get out of control in a situation. The definition of disaster risk represents the concept of dangerous incidents and disasters as the result of continuously existing risk conditions (UNGA Report, 2016). Disaster risk is commonly known because of the relationship between a threat and the features that make individuals and places vulnerable and exposed (see fig 1).

Whereas flooding threat people's life and property. The effects of flooding can be in the form of physical damage to any type of structure like buildings, bridges, roads, cars and sewer systems or else. It also affect water supplies, which can be contaminated, water-borne diseases, crops and food supplies shortage and other species of trees, which are non-tolerant can, die from suffocation. Therefore based on the above Disaster risk definition, flooding is one of unavoidable disaster risk, which occurs in Addis Ababa.

2.2. Disaster Risks in Ethiopia

According to the World Bank (2019) report, droughts and floods pose the most significant and recurring risk to Ethiopia with the highest impacts occurring in the northern and eastern regions. Droughts are prevalent in Ethiopia because of the lowland regions' arid and semi-arid climate and the unequal distribution of water supplies. Every year, on average, 1.5 million people are affected by drought, although this figure can be slightly higher in dry years. Flooding poses a threat to lowland, highland, and urban areas, with 250,000 people affected by floods each year, on average (World Bank, 2019).

According to the NDRMC report on September 2020; only from June to September 2020, flood affects 1,017,854 people and out of them 292,863 peoples was displaced.

2.3. The Concept of Flood Hazard

Flooding has several distinct meanings among them Meyer (2004) defined flooding as flooding is '*the accumulation of water within a water body and the overflow of excess water to adjacent flood plains, or an overflow of inland or tidal waters, unusual and rapid accumulation of runoff or surface waters from any source*'. Flooding is an overflowing or irruption of a large body of water over the surface of the land that temporarily floods an area. Besides, Manandhar (2010), also defined flooding as '*Flooding is a general and temporary*

state of partial or complete inundation of normally dry land areas from the usual and rapid runoff of surface waters which may results from rainfall, rivers, ice melt and so on'.

River flooding, coastal flooding, flash flooding and urban flooding are different forms of flooding. A flash flood may be identified among these types of floods as a sudden flood of low-lying areas, rivers and streams that are caused by the intense rainfall associated with a thunderstorm and they occur when a man-made structure, such as a dam, collapses. If the ground under a storm is flooded with, water so rapidly that it cannot be absorbed, therefore flash flooding occurs (Sinafikish 2013).

The runoff accumulates in low-lying areas and flows downhill easily. Grabs (2011) and Bariweniet.al (2012), cited in Sinafikish (2013), concluded the concept of flooding in such a way that flooding occurs when wetlands, reservoirs, and river beds are unable to retain extra water due to sedimentation or other related factors, and it also occurs when soil and vegetation are unable to absorb or penetrate all water from runoff or other sources.

2.3.1. Flood Risk in Ethiopia

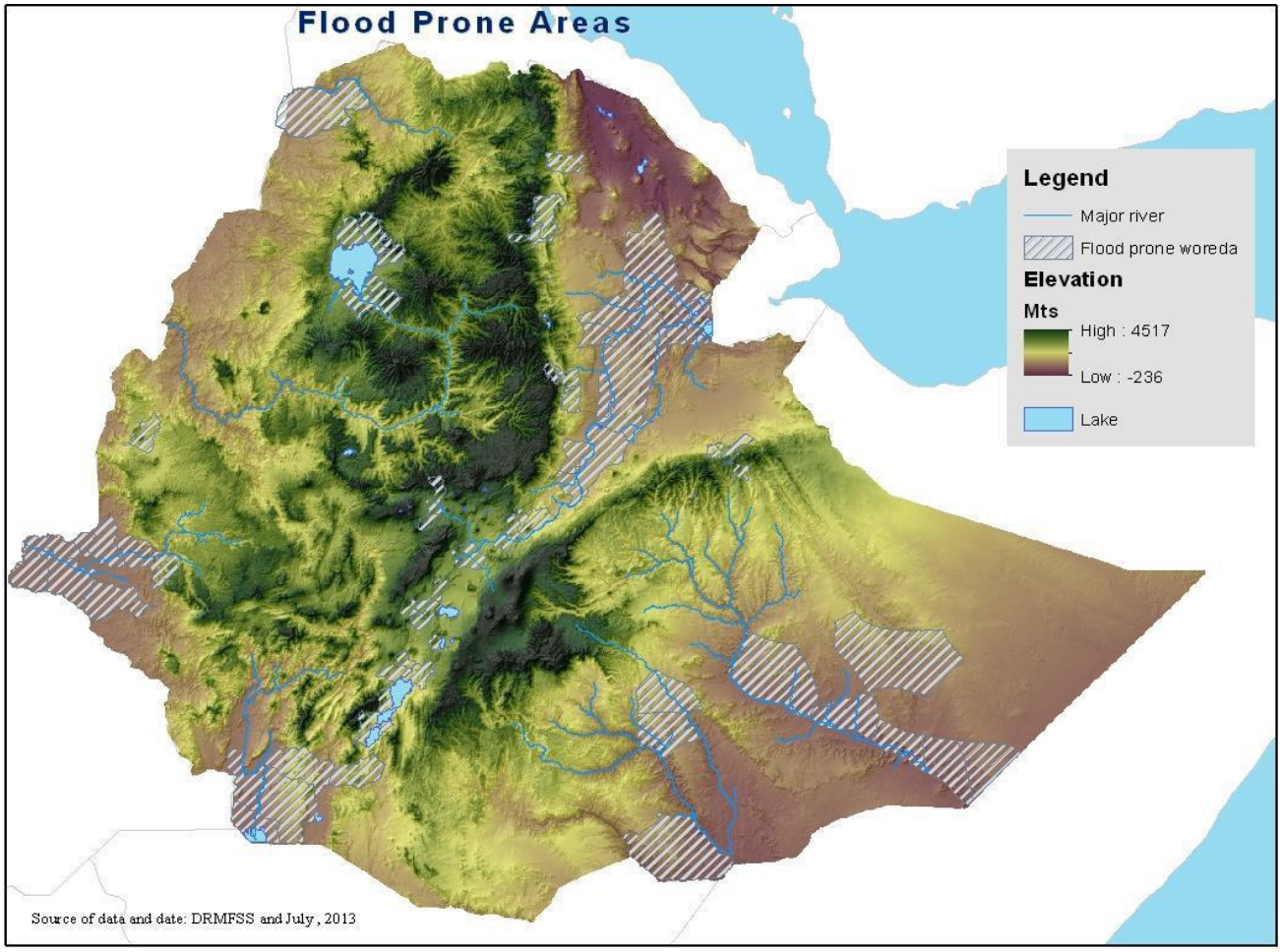
Flood is one of the major natural hazards in Ethiopia, wreaking havoc on lives and livelihoods in various parts of the country. Flooding in Ethiopia is mainly occured by heavy rains and the topography of the highlands and lowlands, which are connected by natural drainage systems created by the major river basins (NDRMC, 2018).

Excessive heavy rainfall has taken the major responsibility for flooding in the country. This is because excessive heavy rainfall is the reason for rivers to overflow and inundate areas along river banks in lowland plains. Parts of Oromia and Afar regions lying along the upper, middle, and downstream plains of the Awash River; parts of Somalia along the Wabe Shebelle, Genale, and Dawa Rivers; low-lying areas of Gambella along the Baro, Gilo, Alwero, and Akobo Rivers; down-stream areas along the Omo and Bilate Rivers in SNNPR; and the extensive floodplains surrounding Lake Tana and the banks of Gumera, Rib and Megech Rivers in Amhara are among the major river flood-prone areas (NDRMC, 2018).

Flash flood occurs in lowland areas due to heavy rains fall in neighbouring highland areas. Flash floods mostly affect the Northern, Southern, and Western Tigray regions; the Amhara region's Wollo, West Gojjam, and Oromia zones; the Afar region; the Oromia region's North

Shewa zone; the SNNPR; the Somali region; the Dire Dawa City Administration and Addis Ababa. This form of flood is distinguished by its sudden onset and lack of early warning, frequently causing significant damage to lives, livelihoods, and property.

FIGURE 2-1: Flood Prone Areas in Ethiopia



Source: DRMFSS, 2013, cited in Federal Democratic Republic of Ethiopia National Disaster Risk Management Commission, Flood Alert #3, June 2018)

According to the Joint Government and Humanitarian Partners (2006) report, the soil in most areas, particularly in the western, central highlands and north western parts of the country, has been saturated as a result of prolonged and intense rainfall, causing rivers to overflow and flash floods in many areas.

Major human deaths, displacements and suffering as well as property loss and crop damages resulted from the flood situation. The issue was the worst one witnessed in recent years. Dire Dawa, South Omo Zone of SNNPR, and some parts of Amhara, Oromiya, Gambella, Somali and Tigray regions are the most flood affected areas of the country.

2.3.2. Flood Risk in Addis Ababa

Addis Ababa is the capital city of Ethiopia with the total population of 2,800,000 (2007 population census). Addis is located on central Ethiopia's high plateau, which is associated with the Rift Valley's North–South mountain systems. Mount Yarer, Mount Entoto, and Mount Wochecha overlook the city from the east, north, and west, respectively. Several small streams flow into the metropolitan area of Addis Ababa those streams are originates in the mountains hill surrounding the city. During the rainy season, heavy rains increase the flow of these streams, inundating the settlements built along their banks on a regular basis (Desybel 2020). In Ethiopian history the worst flood were occur in August 2006 and impacted 363,000 people and forced 200,000 people to flee their homes (DPPA, 2006). The death toll was reported to be about 647 people, but the effects on health and well-being was much higher.

Historically, Addis Ababa is recognized as one of the largest Cities in Africa (Desybel, 2020). Unplanned urbanization and unplanned development have resulted in significant socioeconomic, cultural, and environmental issues (UNCHS, 2007). Flooding is caused by a massive expansion of the buildings, erosion, poor urban planning, squatter settlements, and a lack of integration between road and urban drainage infrastructure. Flood risk has increased since the founding and expansion Addis Ababa. It is linked to rapid urbanization practices such as cropland loss, increased runoff generation, uphill deforestation, and a lack of urban drainage infrastructure, all of which lead to flooding. The Akaki river basin is formed by the Big Akaki and Little Akaki rivers, which flow from north to south through the cities. Because of its topography, which includes steep mountainous and low-lying flood plains, and the heavy rainfall that occurs during the kiremt rainy season, Addis Ababa is prone to flooding (Desybel 2020).

According to Addis Ababa Disaster Risk Management Commission annual performance report, during the last three years, flooding has occurred 83 times in Addis Ababa and it cause for 6 peoples death with financial loss of 7,617,100 birr.

TABLE 2-1: flooding hazard in Addis Ababa during 2018 – 2020

Years	No. flood hazards	Dead	Property damage in birr
2018	24	2	3,907,200
2019	32	1	519,400
2020	27	3	3,905,500
Total	**83**	**6**	**7,617,100**

Source: AADRMC and own analysis

2.3.3. Flood Risk in Akaki Kality

Gentle morphology and flat land areas of the city characterize Akaki. Flooding is prevalent in the sub city due to the topography with low-lying flood plains and the heavy rainfall that occurs during the Kiremt rainy season. Akaki kality is endowed with two major rivers Small Akaki and Big Akaki Rivers. Those two sub-watersheds are the main sources of surface and ground water to the Addis Ababa City. Several primary, secondary and tertiary streams from the Tafo and Legedadi rivers catchments create the big Akaki river.

According to Desybel 2020, flooding and vulnerability issues in the Akaki Kality have risen dramatically in the last decade as a result of a number of factors, including shifts in land use in flood-prone areas, houses built near to river streams and substandard constructions, and increased household density. As a result, overland surface water runoffs have risen and fallen over time. This is because roads, houses, and buildings prevent rainwater from being absorbed into the earth (AACFEPRA, 2018).

TABLE 2-2: Flood risk areas in Akaki Kality

Woredas	Specific locality (sefer) names	Causes
01	Gara Medhanialem and Alliance wetat maekel	Heavy Rain
02	Dimdim sefer	Heavy Rain
03	Megala, biretta biret and Mesjid sefer	Heavy Rain, Akaki River
04	Zenit gebs eshet	Heavy Rain
07	Sefera Medhanialem	Heavy Rain, Addis Ababa

		sewerage & sanitation
08	Abu Chefe, Condominium & Melka Shedi	Heavy Rain, poor drainage system
09	Kilinto	Heavy Rain, drainage & the water flow shift to the villages

Source: Akaki Kality Fire and Disaster Risk Management Commission and own analysis

2.4. Causes of Flooding

Metrological, hydrological, and anthropogenic factors are the three primary causes of flooding. Those three major factors trigger flash floods natural factors such as convective thunderstorms; high rainfall intensity and length; and the topography and slope of the receiving river catchment may all contribute to this form of flooding. There are also manmade factors such as catastrophic failure of water-retaining facilities, insufficient drainage infrastructure, surface conditions (impervious pavement), weak or no drainage system, unplanned human settlement, and encroachment on vulnerable habitats, there are also natural factors (Bloch , Jha, & Lamond, 2011).

Mulugeta (2016) mentions that natural threats such as earthquakes, landslides, Tsunamis, and hurricanes, on the other hand human-caused (technological) hazards such as dam breaks, fail levees, dykes, weirs, and terraces, are the causes of flooding. Climate change and the growing demand for housing and industrial properties appear to increase the risk of flooding, and many construction activities in flood plains will exacerbate the risk and consequences of flooding (Elliott and Leggett, 2002).

The land use and land cover changes can cause for flooding. Many land use practices are generally recognized as leading to increasing flood frequency and severity because of changes in land use patterns, such as growth of the population, road development, deforestation and various arable and grassland management practices.

land use changes and land use activities will significantly lead to changes in all those processes that are hydrological processes in the catchment area. Furthermore, as human alteration and development of the catchment area increases, the runoff generation process changes, especially due to decreased soil infiltration ability and changes in soil cover. This

has caused widespread concern regarding humans, who play a major role in growing flood hazards by modifying catchments (WMO, 2009).

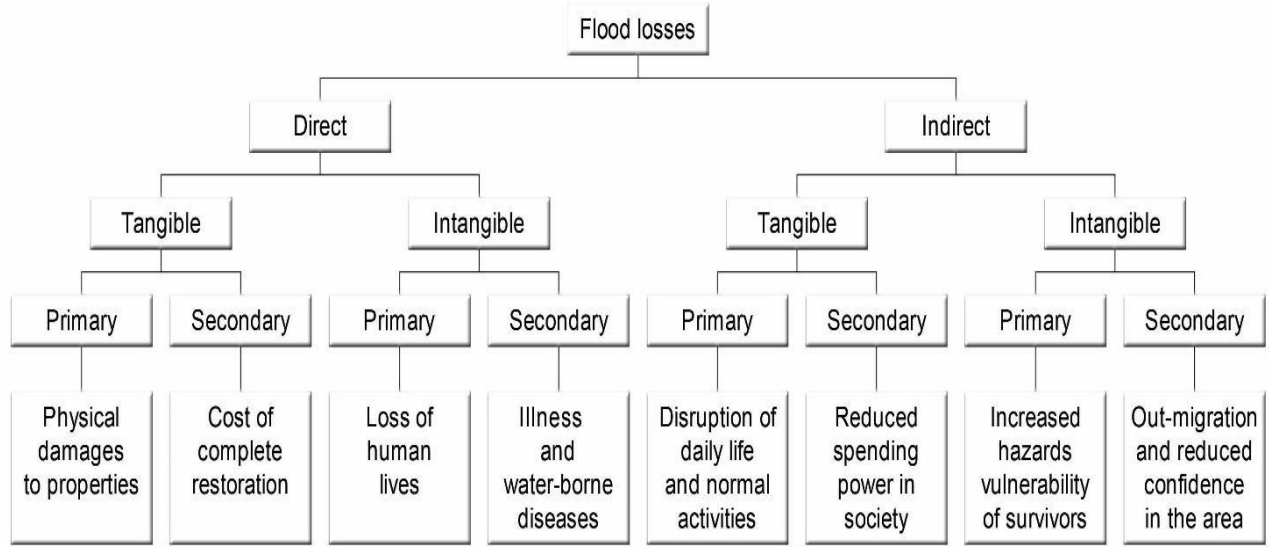
2.5. Consequences of Flooding

Flooding has direct and indirect consequences Lucena *et.al* (2006), cited in Sinafikish (2013),

- **Direct Effects of flooding:** it is characterized as damage caused by the physical contact of floodwaters or when peoples or when floodwaters directly impact people or objects. Direct losses from floods (deaths, injuries, homelessness, sedimentation, pollution, building and infrastructure collapse) are included (Zein 2010). Furthermore, diseases, psychological effects, short and long-term economic losses are also mentioned as examples of indirect losses and consequences of flood.

- **Indirect Effects of Flooding:** it is indirect losses which are less apparent but often operate over a long period of time (Desyibel 2020). These damages are classified as tangible or intangible depending on whether they can be measured in monetary terms (Smith et al, 1998, cited in Gautam and van der Hoek, 2003). Primary and secondary types may be applied to both tangible and intangible losses. Primary losses occur as a result of the disaster, while secondary losses occur at least one phase away from the flood (See Fig.2-4.).

FIGURE 2-2: Flood loss classification



(Source: Smith et al, 1998, cited in Gautam and van der Hoek , 2003)

2.6. The Concept of Disaster Risk Management

Regarding with the increasing of threats of disasters and hazards throughout the world, it is important to take steps to mitigate them better both in the short and long term periods. Disaster risk reduction and disaster risk management are the best components that are used to minimize and handle disasters risks. Jegillos (1999; 2003) mentions that as prerequisites for any disaster risk management to be effective is the establishment of clear policy guidelines which needs to *"address all aspects of disaster risk management that ensures mitigation as a proper priority".* Assessments and monitoring of hazards, vulnerabilities, and capacity are also taken in to account in order to accurately identify appropriate prevention and mitigation measures.

DRM was described by UNISDR (2005) as a structured method of using administrative decisions, agencies, organizational skills and capabilities to enforce social and community policies, strategies and coping capabilities to reduce the consequences of natural hazards and associated environmental tragedies. This covers all types of operations, including structural and non-structural interventions for the prevention and mitigation of adverse hazard effects. Disaster risk management is a systemic mechanism that incorporates risk identification, and mitigation, as well as disaster preparedness, emergency management and rehabilitation/reconstruction to reduce the effects of hazards.

Disaster risk management is a public policy concern involving administrative decisions, programs and strategies aimed at mitigating the impact of hazards and preventing their occurrences by managing vulnerability, ensuring that a society is prepared to take precautionary measures and developing organizational devices that can respond efficiently to disasters as they occur. Different nations have used various forms of administrative framework and organizations tailored to their needs for the management of disasters (Kim and Lee, 1998).

Altogether, DRM seeks to reduce risk by minimizing threat exposure, reducing vulnerabilities, and increasing capacity to create disaster resilience. To this end, DRM institutions are established in various countries with the aim of preventing natural and manmade disasters. Ethiopia already has a National Disaster Risk Management Commission in place to help the country prevent disasters. Similarly, the Addis Ababa Fire and

Emergency Prevention and Rescue Authority are responsible for disaster risk management in the city.

Disaster risk management includes coordinating, preparing and executing actions for disaster preparedness, response or recovery (UNDDR, 2017). Four interdependent, primary phases are involved in the dynamic, multi-actor phase (Fig. 2-2): preparedness, reaction, recovery and mitigation. The dangerous incident occurs between the *preparedness* and *response* phases, as demonstrated.

***Pre-disaster measures*:**

a. ***Mitigation/prevention*:** policy/regulatory and physical interventions to determine and/or mitigate disasters aimed at ensuring that they are mitigated. Prevention/mitigation steps not only minimize the effect of threats, but also reduce vulnerability and improve the resilience of the risk-prone group. In a flood-prone country like Ethiopia, for example, land use planning, agro-forestry, drainage system, building walls etc. could forestall possible problem. Dams and embankments in a potentially flood zones can also reduce losses from floods.

b. ***Preparedness*** recognizes that community and property are vulnerable to hazards, and that the incidents of dangerous events will still require preparedness to be handled. This includes initiatives such as the creation of an emergency relief center, the formulation of emergency disaster preparedness plans, the preparation of individuals and vulnerable populations to be able to rescue and recover as and when disasters occur. Therefore, the envelope of preparedness covers managerial and technological measures taken to reduce damages only before, after and after a disaster.

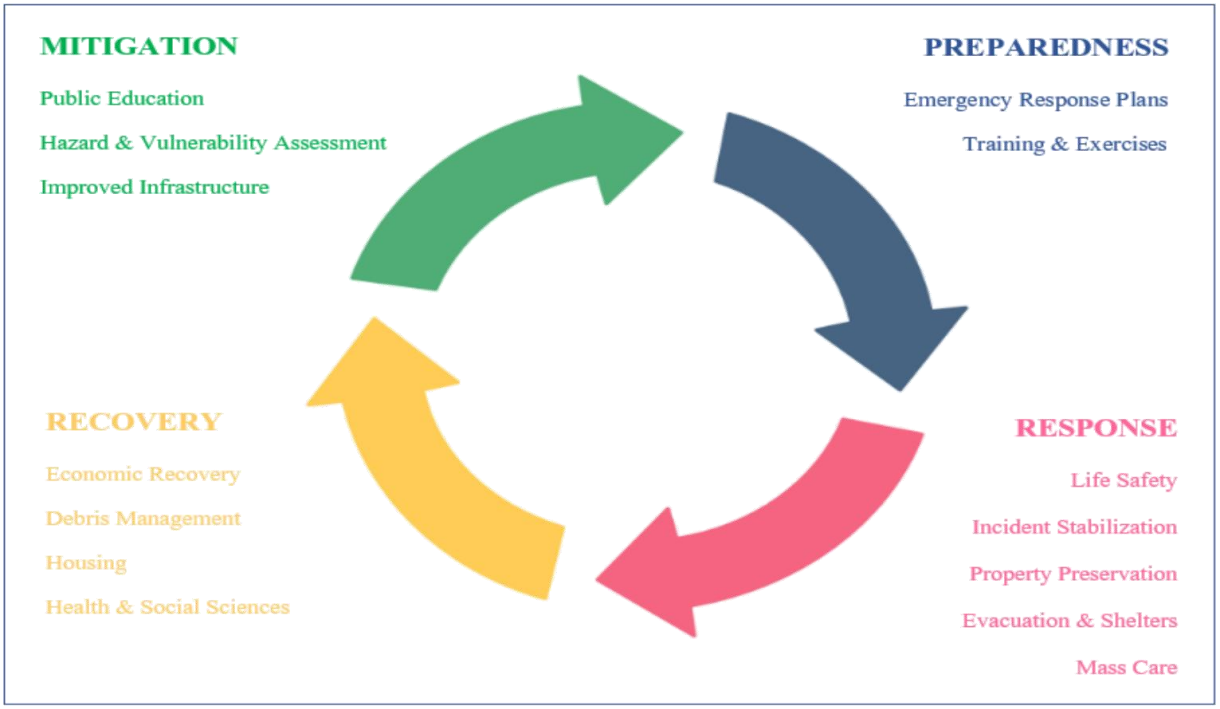
Post-disaster actions:

c. ***Response*** is preparedness in action, whereby steps are taken during and immediately after the disaster effect to ensure that the impacted communities are evacuated from the disaster zone and that emergency medical services, food, shelter, clothing are provided. Exploration and rescue operations, concerted and coordinated actions taken to alleviate the suffering of the victims and speed of responses along the

lines expected are indeed the acid tests of the administrative machinery put in place during and immediately after disaster.

d. ***Recovery*** ranges from damage assessment and remains clearance operations to measures taken to help victims return to daily life and reintegrate them into routine community functions. Attempts to restore normalcy also include the provision of temporary jobs and the recovery of lost livelihoods, traumatized group psychosocial rehabilitation, building and infrastructure replacement, and lifeline services. The recovery task of rehabilitation and reconstruction starts shortly after the emergency phase ends, and it should be focused on pre-existing plans and policies that foster specific institutional obligations for recovery action and enable public involvement. Following a disaster, recovery efforts, in coupled with increased public awareness and engagement, offer a valuable opportunity to establish and enforce disaster risk reduction strategies, as well as to incorporate the "build back better" concept (Kim and Lee, 1998).

FIGURE 2-3: Emergency Management Cycle



Source: Onslow County, 2019

Generally, disaster management require communicate, prepare and coordinate rapidly between local, state and federal emergency response agencies and combine municipal and

private sector agencies (Onslow County, 2019). The difficulty of disaster management is added to by these various levels of government and hierarchies. A multi-threat and multi-sector strategy (with a lead agency for flooding hazard management); a risk/vulnerability profile-based system; proactive ex-ante preparedness and disaster risk reduction; and a full disaster risk management cycle are all part of the DRM approach (prevention, mitigation, preparedness, emergency response, recovery and rehabilitation).

2.6.1. Flood Risk Management

Preparedness before a disaster occurrences, reaction during a disaster, and recovery methods after a disaster are all part of flood risk management (Hobeika et al, 1985). One of the most important ways to solve flood protection problems is by flood risk management. It includes floodplain management, flood control restoration operations, floodplain protections, other flood threat mitigation activities, and flood risk preparedness in cases where mitigation activities are unable to completely prevent flooding.

Flood risk management encompasses flood reduction, control, and floodplain management (MRSC, 2015). Historically, flood management policies have mostly focused on reducing flood waters. This has been done in part by the establishment of some kind of levies by the streams to control floods. Traditional floodplain management methods have also largely focused on regulating the design of buildings and the placement of infrastructure in the floodplain (FEMA, 2009). Flood Risk Management guidelines, when adopted; significantly minimize potential flood losses in the event of their occurrence (Twumasiwaah, 2016).

2.6.2. Effectiveness of DRM System

The Hyogo Framework for Action 2005-2015: Building Disaster Resilience in Nations and Communities (HFA), which elaborates the five priorities for action adopted by the World Conference on Disaster Reduction to achieve its strategic objectives by 2015, reflects the core elements of the DRM foundation. The Food and Agriculture Organization of the United Nations (FAO) released Disaster Risk Management Systems analysis guidelines in 2008, based on the Hyogo Concept, to help improve existing DRM systems.

The major areas are:

- Building institutional and technical DRM capacities at the national and/or decentralized levels;

- Incorporating main DRM elements in to emergency recovery programmes;
- Community-Based Disaster Risk Management (CBDRM) planning and promotion;
- Putting the paradigm change from reactive emergency relief to pro-active DRM in to practice; and
- Mainstreaming DRM into sectoral and development planning (e.g. agriculture, infrastructure, health, transport etc.).

According FAO (2008), DRM systems will be critical in evaluating and improving the institutional capacities required achieving the HFA strategic goals, which are all intertwined with the larger sense of sustainable development. The strengths and weaknesses of DRM systems can either help or hinder development progress.

Addis Ababa is the country's capital city and home to 25% of the urban population. The city's population is projected to double in the next 10 to 15 years at its current rate of urbanization. The city is vulnerable to shocks and stresses that could hinder its efforts to meet its development objectives. Addis Ababa will experience exponential urban development in the coming decades will build the agglomeration of people and economies that will propel the city toward its long-term goals, but if not well controlled, it may intensify existing shocks and stresses related to natural hazards, access to basic services, pollution, economic opportunity, and individual well-being (World Bank, 2015).

Despite the city's major investments, infrastructure provision, which underpins urban economic growth and service delivery, is significantly lagging. Furthermore, the city government's overall structure is complicated, involving a variety of institutions, authorities, and city and federal government enterprises with a variety of functions and obligations in the construction and management of infrastructure. This necessitates a great deal of coordination's.

In general, all of Addis Ababa issues necessitate an effective DRM system, particularly because they are highly related with international sustainable development goals and agendas. As a result, integrating HFA priorities into the city development plan might be able to address the current issue.

2.6.3. Challenge of Disaster Risk Management

Disaster is a major threat that can jeopardize a nation's economic, social, and physical growth, as well as its people's well-being. The destruction, as well as the loss of property and

life, caused by the disaster is enormous and unwelcome in any country. Only by providing a strong and well-coordinated disaster management plan, such as reducing disaster risk, a recovery plan, and a highly prepared response team that includes the government, will the country minimize losses and loss of life while moving forward and achieving the status of a high-income developed country. However, policy implementation, especially in disaster management, necessitates not only coordination, cooperation, and dedication among related agencies, but the community is also the first responder when disaster strikes. There are three popular DRM challenges, according to (Chong and Kamarudin, 2017):

1. An inconsistency in disaster management planning between top-down and bottom-up approaches;
2. A lack of coordination across the disaster management cycle, with a greater emphasis on the disaster emergency response stage; and
3. A lack of planning for long-term recovery (post-disaster), resulting in low community and stakeholder resilience.

2.7. The Concept of Institutional Collaboration

A single organization will not respond effectively to the complex nature of the problems in the world. Rather, collaboration is necessary in order to respond adequately to the multiple pressures of aggravated disaster risk threats. Collaboration has therefore become a method for resolving the complex existence of natural and environmental concerns (Chrislip, 2002). The word collaboration is commonly substituted with cooperation and coordination. For instance, a dictionary meaning of collaboration is cooperating, coordinating and working in fusion with others. Collaboration should not be understood to mean sub-contracting, but a true relationship between institutions based on mutual respect and recognition of the autonomy of the vision and strategy of the collaborating organizations. Therefore, its main purpose is to establish a common vision and collective solutions to solve problems that go beyond the reach of any particular sector.

Many scholars define collaborations in different ways. Few are listed below on table 2-5 which institutional collaboration definitions are aligned with this study.

TABLE: 2-3: Definition of Collaboration

Definitions of Collaboration	Sources
Collaboration is the set of communicative processes in which individuals representing multiple institutions engage to address issues like disaster & hazards	Keyton, Ford, & Smith (2008)
Collaboration is defined from the perspective of disaster management and inspired by the IFRC, when actors join hands across relationships and sectoral boundaries to evaluate a situation, initiate and work on a coherent response to mitigate negative impacts from disasters. But the factors of internal legitimacy, power balance, integration and trust can also warn of the impact on collaborative processes.	(Hermansson, 2016)
Collaboration is "a dynamic team and group... [that] happens within and across institutions, but also inhibited within partnerships and networks."	Gazley (2017)

Mattessich et al. (2001) defined six categories as a framework for assessing effective institutional collaboration. Trust and partner compatibility; shared governance and joint decision-making; common comprehension of roles and responsibilities; transparent and regular communication; and sufficient financial and human resources are among them.

2.8. Disaster Risk Management Institutions in Addis Ababa

Since Addis Ababa is the capital city of Ethiopia, the city is home to both governmental and non-governmental organizations working on DRM. Of these various institutions, NDRMC, Addis Ababa City Government Fire and Disaster Risk Management Commission and Akaki Kality Sub City Fire and Disaster Risk Management Commission are the focuses of this research.

2.8.1. National Disaster Risk Management Commission of Ethiopia

NDRMC was formed by converting the DRMFSS into a full-fledged Commission in 2015. This has significantly improved the legal and organizational structure at national and local levels for a robust and integrated national DRM system. It is driven by the National Disaster Risk Management Policy and by 2013 and the Strategic Program and Investment Framework for 2014. It changed the organisational landscape of DRM in Ethiopia and created as an autonomous federal government office, which is accountable to the Minister of Peace.

The NDRMC mandated and consist of multi-departmental and multi-sector collectives of individuals representing designated organisations. The NDRMC council is chaired by the Prime Minister, and members of the council are several, but there are lead sectoral ministries and institutions include the MoA, MoH, MoWIE, Ministry of Federal Affairs, MoE and NMSA. There are many international, aid agencies and multilateral organizations that work very closely on flood disasters alongside the government structure at the Federal and Regional level starting from the early part of the field assessment to the mobilization and distribution of relief food and other goods for the flood victims.

Coordinating of disaster response, risk management, preventive measures and recovery programs in the country is the responsibility of the Commission. It operates through a well-established framework, roles and responsibilities as clearly listed in council of Minister's Regulation No. 363/2015. Overall, it has a vision to reduce disaster risks and possible hazards caused by a disaster through the establishment of a comprehensive and coordinated DRM system in the context of sustainable development (Proclamation No. 363/2015). In general, a long account that suggested a complex task passed through the historical growth of DRM organizational setup.

2.8.2. Addis Ababa Fire and Disaster Risk Management Commission

There are currently nine branches and one Disaster Risk Management training institute. When opposed to before, this helps the community to use the service more quickly. This now includes a variety of technological disaster mitigation machines, fire engines, and rescue vehicles, as well as disaster risk management qualified human resources.

In General, the current institutional structure is critical to overcoming the catastrophe that has occurred in Addis Ababa if it is implemented effectively. This institution is now working with the Disaster Preparedness Funds and Logistics Management Directorate in Addis Ababa to avoid COVID 19. This directorate distributes food and non-food goods to the local community. Fig 2-6 shows that the overall organizational structure of Fire and DRM for Addis Ababa City.

2.9. Review of Empirical Studies

There are several research works on the practices and challenges of disaster risk management and on flood risk assessments in various places. Most of the research works on the flood related focused on rural areas and their scope was limited on flood risk assessments. From the previous empirical studies few studies have reviewed the disaster risk management practices. Using qualitative approach (Jemberu Mola, 2019) analysed the practices, challenges and opportunities of institutional collaboration in disaster risk management in Ethiopia since 2015. (Melis Nigatu, 2020) also conducted the study on the practices and challenges of disaster risk management in urban area; the case of Addis Ababa city, Ethiopia by using comparative descriptive research design and found that In Addis Abeba, urban disaster risk management faces the following challenges: insufficient levels of implementation of policies set to each phase of DRM components, lack of codes appropriate implementation, inconsistency of people awareness creating campaign, faller of long-term recovery (post-disaster phase) planning, and poor institutional collaboration habits. (Desybel Minwuylet, 2020) also studied A Geospatial Technology Based Study on Flood Risk Assessment in a case of Akaki Kality Sub City, Addis Ababa, Ethiopia.

Outside of our country there are different related research works and articles. A study also had been carried out in Barangays, (2014), the flood disaster risk reduction and risk management of Pasig city. The finding shows that the Flood Disaster Risk Management-Disaster Risk Reduction (DRM-DRR) programs of the Pasig City as effective.

2.10. Conceptual Framework

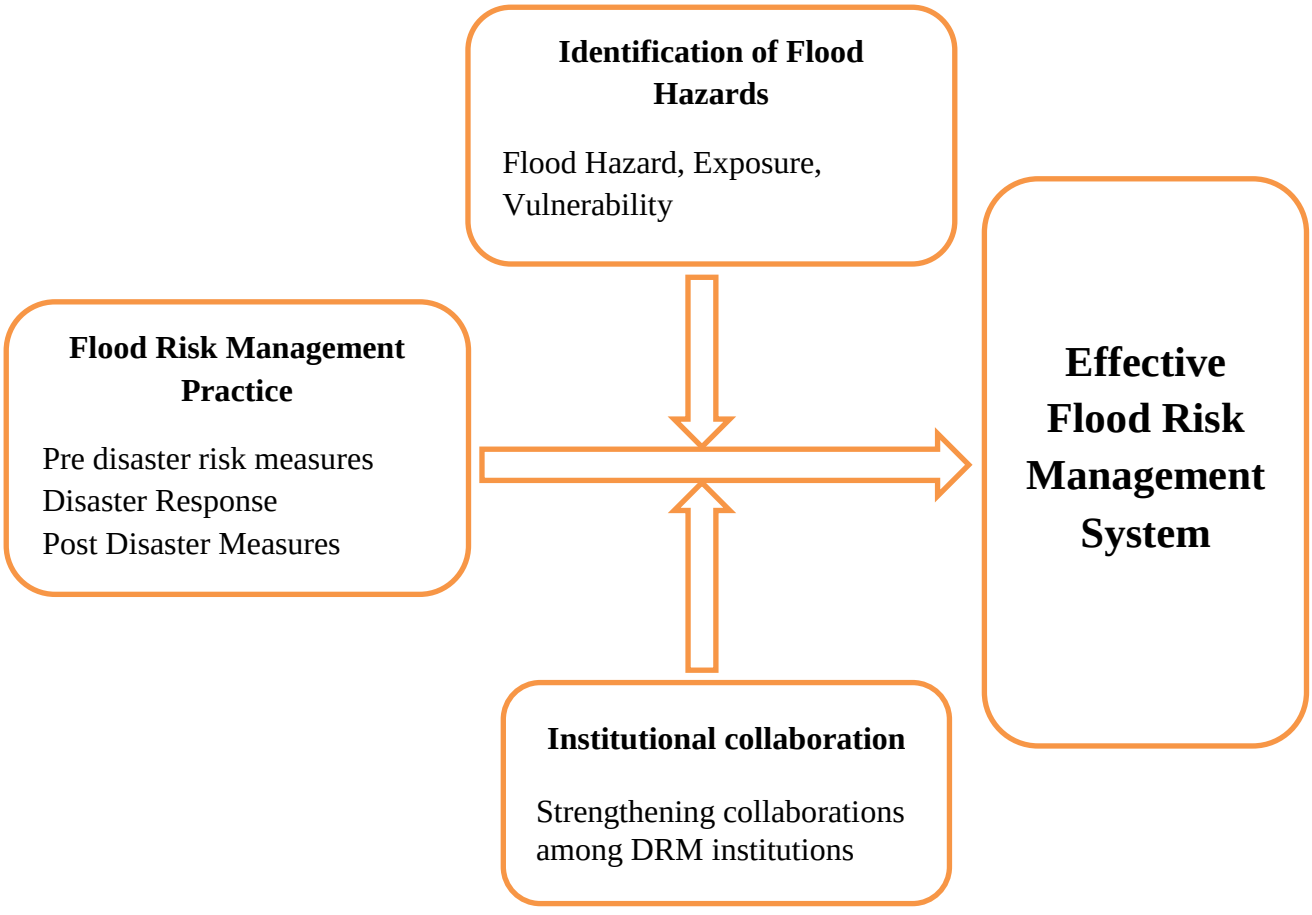
According to the literature study, flood risk management entails coordinating, preparing, and carrying out actions for disaster preparedness, response, or recovery. The UNDDR 2017 report, the dynamic, multi-actor phase of preparedness, reaction, recovery, and mitigation has four interconnected major phases. Based on the UNDDR DRM concept, the researcher assess flood risk management practice in Addis Ababa by investigating pre-disaster, during-disaster, and post-disaster actions implemented by DRM institutions.

The purpose of flood risk management is to reduce the underlying factors of flooding while also preparing for and initiating an immediate response in the event of a flood. As a result,

flood risk hazard map using GIS is necessary. Effective FRM practices should focus on strengthening communities' capacity and resilience to safeguard their lives and livelihoods through measures to avoid (prevention) or reduce (mitigation) the adverse consequences of hazards, as well as providing early and credible hazard forecasts. Different institutions should collaborate with DRM institutions to strengthen the FRM system.

In general, the diagram hereunder is adopted from the literatures to assess the effectiveness of flood risk management system by focusing on flood risk identification, FRM practices, and institutional collaborations on FRM.

FIGURE 2-6: Conceptual Framework



Source: adopted from UNDDR (2017) and modified by the researcher

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Description of the Study Area

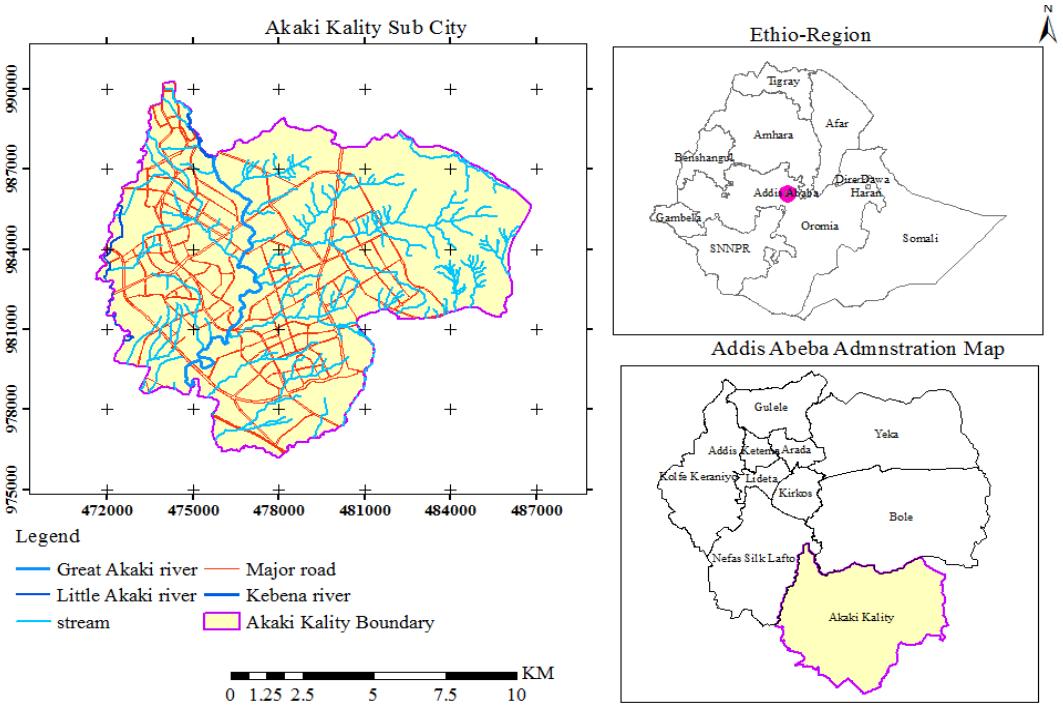
The study is being carried out in Addis Ababa with focusing in Akaki Kality Sub city. Addis Ababa is the capital city of Ethiopia since 1886, which is situated at 9°148N 38°4424E coordinates and is just 75-100 kilometers from the western edge of the Main Ethiopian Rift Valley. After its establishment is more than 130 years ago, the city has developed from a small and dispersed settlement to a metropolitan urban area of 527 km2 (Alemayehu 2005) with an estimated population of 3,273, 000 people, according to the CSA (2014). The city is home to 25% of Ethiopia's urban population and is one of the fastest growing cities in Africa (UN-HABITAT, 2017; World Bank Group, 2015). Addis Ababa is the also political hub being the head quarter for the African Union and United Nations Economic Commission for Africa.

Arada, Addis Ketema, Yeka, Kirkos, Lideta, Kolfe, Akaki Kaliti, Nifas Silk Lafto, Gulele, and Bole were the ten sub cities of Addis Ababa. Currently, Lemi Kura has been designated as Addis Ababa's 11th Sub-City, which is made up of portions of land from Bole and Yeka sub-cities. The new sub city has yet to fully emerge and is not yet operational. There are woredas & ketenas, which are the lowest administrative levels, under each sub city.

According to UN-HABITAT (2017), Addis Ababa's rapid and uncontrolled population growth and spatial expansion has caused significant environmental destruction. Slums and informal settlements have posed a significant challenge to the region, and are widely regarded as the main issue affecting people's livelihoods and the condition of the urban environment (Dubbale, et al., 2010). Addis Ababa is expanding in both height and width, resulting in changes to the landscape and land cover in and around the region.

Due to river overflow caused by heavy rainfall events in the upper catchments, Addis Ababa is vulnerable to both riverine and flash floods. Flood risk will increase in the future as a result of more regular heavy rainfalls, according to climate change predictions. Housing construction along river banks by using vulnerable housing materials such as mud and wood and inadequate drainage systems along highways, all contribute to flooding vulnerability (World Bank, 2015). The study has chosen Akaki Kality sub city as the study site of the study which is discussed further below.

FIGURE 3-1: Map of Akaki Kality Sub City



Source: GII (2021)

As it is shown on figure 3-1, Akaki Kality is amongst the largest sub-city in the town and the largest industrial area. It covers a total area of 118.08 km^2. The GPS coordinates were 8°53 5 N and 38°47 21 E for latitude and longitude. The sub city is bounded to the north by Bole Sub-city, to the North West by Nifas Silk Lafto Sub-city, and to the south and east by Oromia Regional State. Eleven woredas make up the sub-city. According to the Ethiopian Central Statistical Agency's estimated population for 2014-2019, the population of the Akaki Kality Sub-city was 115,736 males and 122,619 females, totalling 238,355 populations.

The topography of Akaki Kality sub city is both gentle and sloppy. The boundary of the study area is situated along an elevation range of 2060-2340m (Melis, 2020). The topography of a watershed, such as elevation, and slope has a significant impact on the amount of flood hazard. There is a river in this sub city called Akaki River. Akaki River is a central Ethiopian river. It is a tributary of the Awash River on the right side. Among the important tributaries of the Awash is the Akaki River, which flows through the city of Addis Ababa (Desybel, 2020). The Akaki river is divided into two sub-catchments: the Big Akaki (900 km2) and the Little Akaki (500 km2), which flow through the city from the Entoto ridge's southern flank to the Aba-Samuel reservoir's confluence.

3.1.1. Climatic conditions of the Study Area

The climate of Addis Ababa is subtropical highland. The city has a diverse range of highland climate zones, with temperature variations of up to 10°C depending on elevation and wind patterns. The high elevation moderates temperatures all year, and its proximity to the equator ensures that temperatures are consistent month-to-month (Selamawit, 2018). The average year-round temperature is around 18°C, with slightly cooler highs in July and August. In Addis Ababa, there are three distinct seasons. From March to May, there is a short rainy season (Belg), a long rainy season (Kiremt) from June to September, and a dry season (Bega) from October to February. The average annual rainfall is about 1200mm. The wettest months are July and August, which receive about half of the annual precipitation.

Addis Ababa's main wet season runs from June to mid-September. In Addis Ababa, flooding is particularly bad in July and August. Rivers and streams from the surrounding hilly areas flood roads. This time; rivers overflowed, causing damage to housing units and other facilities in Addis Ababa. While it is summer, the temperatures are significantly lower than at other times of the year due to the constant rain and hail, as well as the abundance of cloud cover and less hours of sunlight. Winter fall, and spring are the driest of the seasons. Addis Ababa is particularly dry in the winter (December, January, and February). Autumn appears to be a transitional season between the rainy and dry seasons.

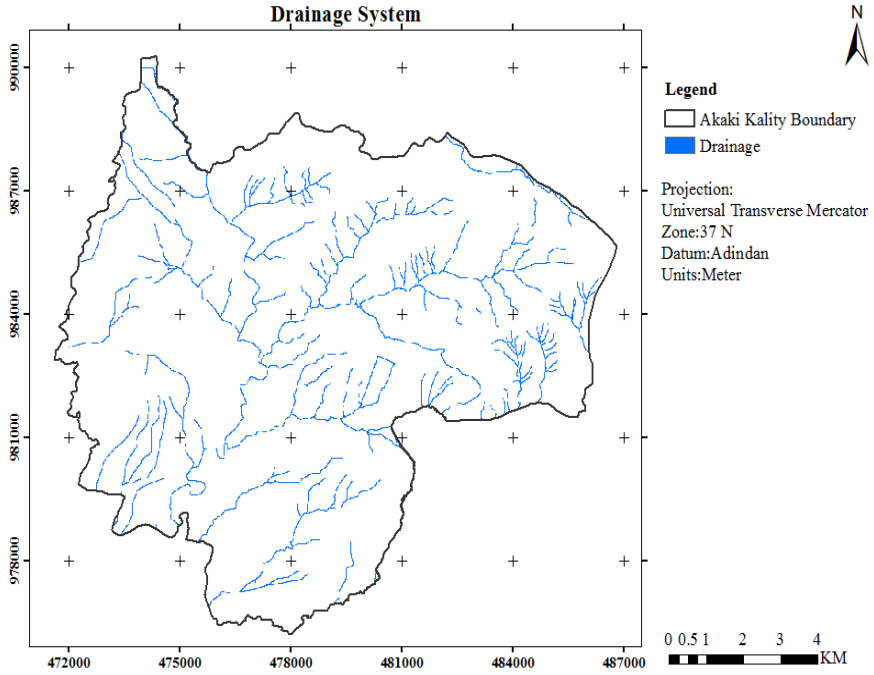
Regarding with the Akaki Kality sub city, the data were collected from National Meteorological Agency (NMA) shows that the major rainy season for the sub city is from May to August. However, December and April months have the least. It has annually maximum 3353.3, 3469.4, mm and minimum 2.9, 35.2 mm total rainfall respectively. According to National Meteorological Agency (NMA), Annual mean maximum temperature was 14.9 and Annual mean minimum temperature was 6.6.

3.1.2. Drainage System

Addis Ababa lies within the Awash River Basin. On the top of Entoto Ridge, the water separates between the Awash and Blue Nile basins. The Akaki River basin is divided into two sub basins: the Big Akaki River (Eastern) sub basin and the Little Akaki River (Western) sub basin, which encompasses the entire Addis Ababa region (Habtamu, S. 2011). Burayu, Gefersa, Leku, Qille, Gerbeja, Worenchiti, Melka Qorani, Kera, and Jaja streams are

tributaries of the Little Akaki, while Ginfile, Kebena, Kechene, Kurtume, and Yeka are tributaries of the Great Akaki. Streams are densely packed with deep valleys on the tops of mountains, such as the Entoto plateau, creating radial and dendritic drainage patterns. The drainage system was digitized from the area's topographic map and depicts dendritic drainage patterns (Fig3.2). The main streams form a parallel drainage pattern that runs roughly north south, with the following streams draining into the Aba Samuel reservoir (Desybel, 2020).

FIGURE 3-2: Drainage System of the Akaki Kality Sub City



3.1.3. Land use, vegetation and ecosystem service in the study Area

The Addis Ababa city is located in the central position of the Aba Samuel reservoir's vast watershed in the Awash River Basin. The Aba Samuel reservoir is a small man-made lake created by a concrete dam constructed on the Akaki River's course as it flows into the Awash River. The reservoir was built as the city's first source of hydroelectric power in the early 1950s (Selamawit, 2018). Entoto and the surrounding volcanic high mountain ridges (3200 m.a.s.l), Bereh (3228 m.a.s.l), Wechecha (3385 m.a.s.l), Yerer (3100 m.a.s.l), and Furi (2839 m.a.s.l) form the broad watershed boundary and drain rain water to the Aba Samuel reservoir through a dense network of streams forming three major sub water. The Addis Ababa City's primary sources of surface and ground water are the Small and Big-Akaki sub-watersheds. As

a result, the management of the three watershed catchments is crucial for Addis Ababa's long-term growth and development (CFES, 2017a).

The Big-Kebena sub-watershed drains the central catchments and is estimated to cover 271 km2 (18%) of the Aba Samuel reservoir's watershed. After entering the Big-Akaki River, the sub-watershed extends from the Entoto mountain ridges in the north to the Aba-Samuel Reservoir. According to Selamawit (2018), the sub-watershed divides the eastern and western catchments of the Small and Big-Akaki sub-watersheds and runs through the central parts of the city to the southern plains.

Eucalyptus plantation forest, mixed forest, and natural forest are the three types of vegetation found in and around Addis Ababa. There are woody, herbaceous, and climber plant species. Land use and land cover management are highly influenced by ecosystem services. When demand for ES exceeds supply, it indicates excessive resource consumption. The nature, state, and degree of land use in an ecosystem affect the supply of ecosystem services. Demand for ecological services is also affected by socioeconomic growth, climate, and urban development in urban areas (Selamawit, 2018).

3.2. Study design and Approach

For the purpose of this study, descriptive case study was employed. This is due to that descriptive case study design will help to carry out an in-depth examination, inquiry and review by describing the nature of a group situation (Yin, 2003) on effectiveness of FRM system and on the collaborative Institutions in flood risk management to reduce flood risk factors. In order to produce a comprehensive analysis of the study, both qualitative and quantitative approaches ware used in this study design.

A) Qualitative Approach

Qualitative approach was used in order to gain a deep understanding on flood risk management: its practices and systems, collaboration among institutions to reduce flood hazards and to improve households livelihood and the city‘s environment. To collect qualitative data, semi-structured interviews and observations were conducted.

B. Quantitative Approach

The quantitative approach were incorporates various technical methods including GIS technologies. Surveys were carried out from Experts and households. It helps to collect data

on the socio economic and demographic information of both experts and households, flood risk management practices (focusing on prevention, mitigation, response and recovery), challenges that faces on flood risk management practices and the way forwards to improve the system.

3.3. Data Source

There are essentially two data sources, namely primary and secondary sources. This study used on both primary and secondary data sources. Primary data was collected through structured questionnaires, semi-structured interviews and direct observations from selected household heads living along the Akaki Kality in Addis Ababa, as well as from three institutions namely; National Disaster Risk Management Commission, Addis Ababa Disaster Risk Management Commission and Akaki Kality Disaster Risk Management Commission. Although, DEM, precipitation/rainfall, Topography Map, satellite image, soil type, satellite/Landsat image and written materials such as books, essays, papers, scientific observations, and other relevant documents were used as secondary data sources. Addis Ababa Disaster Risk Management Commission (AADRMC) was the most relevant secondary data sources. Secondary data also include DEM, precipitation/rainfall, satellite image, soil type, Landsat image were used to carry out.

3.4. Study Population

According to Burns and Grove (1993), all elements (individuals, objects and events) which meet the sample criteria for inclusion in a study are called population. Since this study focuses on flood risk management practice, it involves different institutions who are the first to respond in the city during risk occurrences. The populations of study was include Senior and medium level experts', and directorate directors form National Disaster risk Management Commission, Addis Ababa Disaster risk Management Commission, Akaki Kaliti Sub City Disaster risk Management bureaus. In addition, people living along the Akaki River was included.

3.5. Sample Size and Sampling Techniques

3.5.1. Sample Size Determination

An appropriate sample size for a given study was depending on various factors including research type, availability of resources, and time. Sample size determination was differentiating for households and experts and the details are explained as follows:

A) Sample Size Determination of Experts

The total sample size was obtained from experts who work on three institutions, and the total population was 211. Experts were drawn from different directorates, including Early Warning and Emergency Response, Fire and Emergency Response, Fire and Disaster Response and Rehabilitation, and Disaster Risk Research and Implementation. The three organizations' proportion of the total target population is as follows:

Table 3-1: Total population proportion in each institution

No	Site	No of targeted populations in the organizations
1	Addis Ababa Disaster risk Management Commission	117
2	National Disaster risk Management Commission	55
3	Akaki Kaliti Sub City Disaster risk Management bureaus	39
	Total	**211**

Source: Own survey, 2021

To determine the sample size of the target population, the researcher applies statistical instrument formula which the statistical formula developed by Yamane (1967). The sample size is calculated by using this formula:

$$n = \frac{N}{1+N(e)^2}$$

Where N= Number of Population
n= the sample size
e= the error of 5 percentage points

This formula was used to calculate the sample sizes of experts for the study as follows:

$$n = \frac{211}{1+211(0.05)^2}$$

$$= \underline{\underline{\mathbf{138}}}$$

The sample size was calculated by substituting the numbers into the Yamane formula, and the sample size from the experts were 138.

B) Sample Size Determination of Households

As previously stated in the Literature Review, floods have affected all woredas in the Akaki Kaliti sub-city and one of the most flood prone area on the Akaki Sub city were Woreda 03. This is therefore the study was focused on Woreda 03. According to the woreda 03 environmental protection office, the areas most affected by the floods have been identified. As a result, 52 individual landowners were identifies as severely affected by the floods. However, much number of occupant's was lived under those owners.

Therefore, the Households sample size was determined based on the information acquire from Environmental Protection Office of Woreda 03 (the detail sampling technique described under sampling techniques section below). In addition, the study used 52 landowner households as a target population of this study. This is therefore Yamane (1967), formula was used to determine the study's households sample size as well. The sample size is calculated by using this formula:

$$n = \frac{N}{1+N(e)^2}$$

Where N= Number of Population
n= the sample size
e= the error of 5 percentage points

This formula was used to calculate the sample sizes of households for the study as follows:

$$n = \frac{52}{1+52(0.05)^2}$$

$$= \underline{\underline{46}}$$

The sample size was calculated by substituting the numbers into the (Yamane 1967) formula, and the sample size from the Households were 46. The key informants were chosen purposefully based on their institutional position (all are higher officials). Generally, the study was assumed that the margin of error 5% and confidence level or error free of 95%. According to above formula and target population 184 (both experts and households) participated for primary data collection purpose. So that Desired sample size = 184.

Accordingly, among 263 total targeted populations, 184 were identified as a sample size to respond to the questionnaire at 90 % confidence level and 0.05 precision levels.

Table 3-2: Summary of Sample size determination

	Total population	Sample Size
Experts	211	138
Households	52	46
Total	**263**	**184**

Source: Own survey, 2021

3.5.2. Sampling Techniques

The study was conducted in Addis Ababa because the city is vulnerable to both riverine and flash floods caused by river overflow caused by extreme rainfall events and upper catchment activities (World Bank, 2015). The past recorded on flooding in Addis Ababa indicates that it was increasing from time to time. Moreover, there was wide evidence that the flooding in Addis had been continue to increase to the end of this century due to climate change (Weets, G. 2011 and Feyissa et al. 2018). Furthermore, Addis Ababa is located in the upper Awash River basin, which has a total drainage area of 110,000 square kilometres (Tesfaye Chernet, 1993). Taking this into consideration, Akaki Kaliti sub-city is selected to assess the effectiveness of FRM system.

The study selects Akaki Kality Sub City due to two main reasons. The first one, Flooding is common in Akaki, at a time of heavy rain. This is due to topographic nature of the Southern and South Western were gentle, and the heavy rain drops from mountains flow to the Southern direction, makes the Akaki-Kality area to be more vulnerable to flooding (Desybel, 2020). Secondly, there is a river in this sub city called Akaki River. The Akaki River flows through central Ethiopia and is a right-hand tributary of the Awash River. Among the important headwaters of the Awash is the Akaki River, which flows through the city of Addis Ababa and it flow through the city from the southern flank of the Entoto ridge to the confluence at the Aba-Samuel reservoir. Therefore, Flooding is prevalent in Akaki Kality because of the topography with steep mountains and low-lying flood plains and the heavy rainfall that occurs during the Kiremt rainy season. In addition to this, all 11 woredas in the Akaki Kality sub-city were affected by flooding. Among those, woreda 03 is chosen for the purpose of this study. This was due to the woreda 03 is surrounded by akaki river and the

river uses as boundary for the woreda. In addition to that, this woreda has a good example of FRM activities and many FRM actions were taken on this woreda.

Both probability and non-probability sampling were employed to make selections. A probability sampling was deployed to select the sample size of Households and experts from different concerned institutions.

As shown in Table 3-3 below, the experts were selected from each of the selected organization based on simple random sampling. The respondents were probably from different directorates. The simple random sampling was used for households as well.

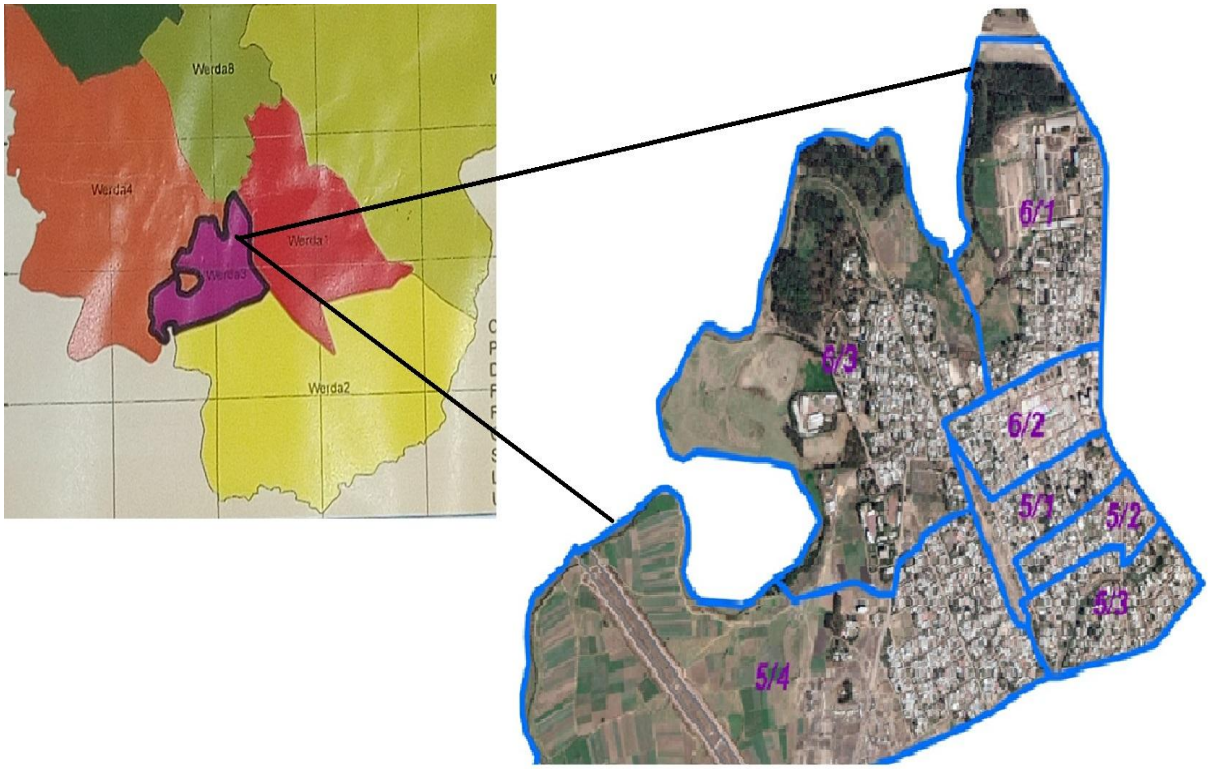
TABLE 3-3: Lists of Sample size proportion of each institution

Site	No of targeted populations	Sample size proportion
Addis Ababa Disaster Risk Management Commission	117	77
National Disaster Risk Management Commission	55	36
Akaki Kaliti Sub City Disaster risk Management bureau	39	25
Total	**211**	**138**

Source: Own survey, 2021

The household respondents were identified based on the woreda 03 environmental protection office; the areas most affected by the floods have been identified at woreda level and in order to make the woreda FRM system more efficient. The environmental office of Woreda 03 initially divided the areas into six different clusters and identifies that cluster 6/3, 6/1 and 5/4 as the most flood affected areas (see fig. 3-4). For this major reason is that those places are very near and boundaries for Akaki river.

FIGURE 3-4: Map of Woreda 03 divided by cluster



Source: environmental protection office of Woreda 03

After that, the prior cluster was then divided into many blocks, and the most flood-prone locations were identified. Based on that cluster 6/3B1, K6/1B1, K61/B6 and K5/4B1 are identified as a major flood prone area (see fig 3-5).

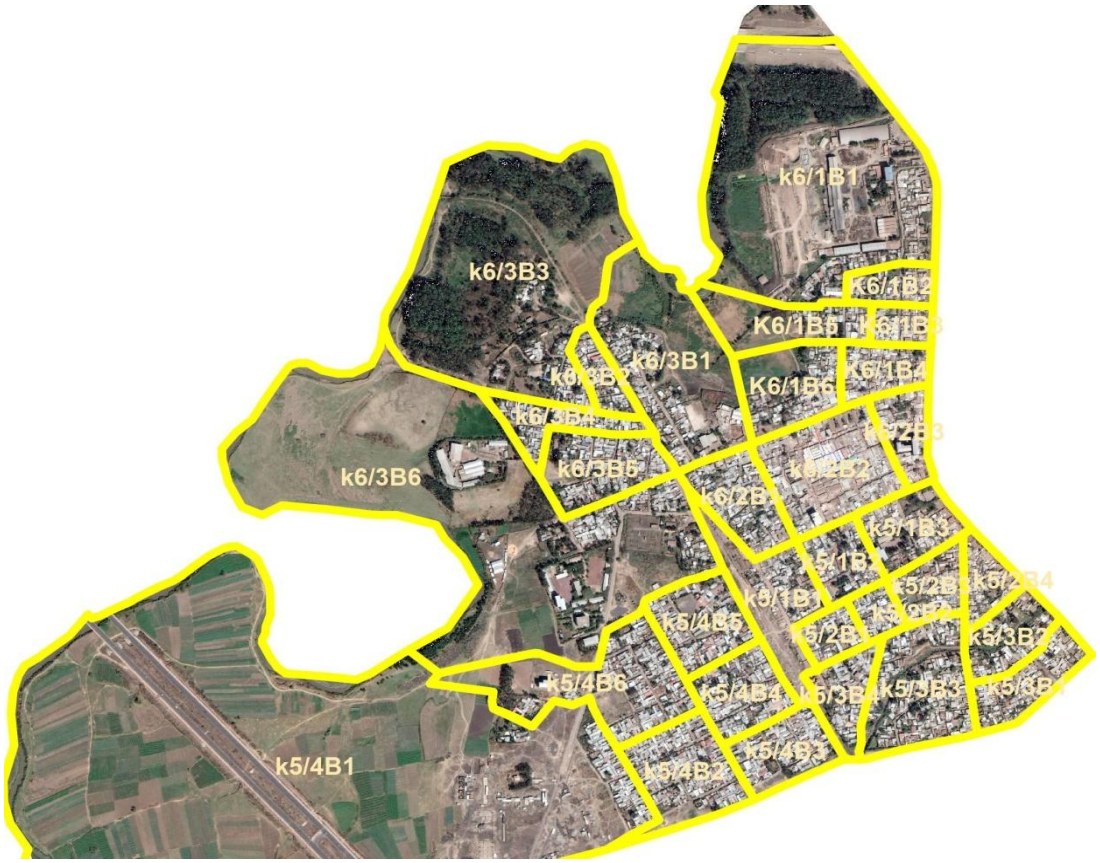
To illustrate the information in detail:

- **Cluster 6/3 block 1 (K6/3 B1):** this place is usually called as megala and masjid sefer, which is known as the most flood prone area. The reason for flooding is Akaki River and heavy rain. Currently, the government taking resettlement actions and only 32 land owner households is remained.
- **Cluster 6/1 block 1 (K6/1 B1):** this place usually known as Akaki Bireta biret or Akaki Metal Factory. On this area the factory take its own retaining walls and trying to decrease flood risks.
- **Cluster 6/1 block 6 (K6/1 B6):** on this place the retaining walls were build but not sustainable. Therefore the government was taking resettlement actions and only 20 land owner households are remained and others were receiving alternatives.

- **Cluster 5/4 block 1 (K5/4 B1):** as shown in fig 3.5 below, the place were farm area and only one sub group were lived and they are taking their retaining systems.

As a result, the researcher focuses on cluster 6/3B1 and K61/B6 K5/4B1 was chosen for the study because it is a place where many land owner households are lived compared to others blocks. This is therefore, the Households sample size were determine based on the above information and the study use 52 land owner households as a target population of this study.

FIGURE 3-5: Map of Woreda 03 divided by Blocks



Source: environmental protection office of Woreda 03

TABLE 3-4: Summary of total samples of both institutions and Households.

Site	No of targeted populations	Sample size proportion
Samples from the experts	211	138
Samples of the Households	52	46
Total	**263**	**184**

Source: Own survey, 2021

A non-probability purposive sampling technique was deployed to determine the most appropriate targets for the selection of certain groups of samples. Institutions higher officials and directors were deliberately chosen because they are the appropriate bodies to respond precisely to the research questions regarding with institutional collaboration. The respondents were from early warning directorate, disaster rehabilitation and response staffs and disaster risk reduction respectively. The validity and reliability of the sampling were maintained by following a maximum variation sample during the Purposive sampling process. This includes the selection of key informants who had the knowledge and competence on the questions regarding with flood risk management practices. This is due to their participation and awareness of the scenario under the study.

3.6. Data Collection Methods

In order to find answers to the research problem and to analyze the findings, data collection is a method of gathering information from all the relevant sources. Data collection approaches can be classified into two categories: secondary data collection methods and primary data collection methods (Dudovskiy, 2018). Both secondary and primary data collection methods were employed in order to obtain detailed and reliable data for analysis.

3.6.1. Quantitative Data Collection Method

A) Household Survey:

Quantitative data were acquired using open-ended and closed-ended questions. Information concerning the demographic information (education, occupations, households duration on the study area and, the areas affected by floods) of households was obtained through interview based household survey. In addition to this, information's about flood risk management practices on their villages were also assessed. Each question was discussed before the data collection to avoid confusion while asking and filling out the questionnaire.

Initially, the question for experts and the households was the same, however the pre-test was conducted on 4 households to evaluate the questionnaires and as the result the question was somehow difficult to understand by the household level as experts. Accordingly, the questions were modified in a way that is convenient for the households. In addition to this Relevant questions were screened out after the pre-test.

The survey was conducted on 46 houses in the households in the study areas. The data were gathered in two ways: the first one was the researcher filled out questionnaires via interview, and second way was they filled out the questionnaires. Ten of the 46 questionnaires were not returned. They were briefed about the research's objectives and contents prior to beginning the survey. To avoid confusion while asking and filling out the questionnaire, each question was reviewed before to data collection.

B) Survey of Experts

Quantitative data were acquired with closed-ended questions. Information concerning the demographic characters of the three institutions was captured gender, age, educational qualification, years of experience and positions of the respondents. It has also captured the respondents' knowledge on preparedness, early warning, response and recovery. For other descriptive questions, respondents were required to state their level of agreement or disagreement on the questions.

The survey was conducted on 138 experts from three DRM organizations. The questionnaires were filled out by themselves. Sixteen of the 138 questionnaires were not returned and only 122 questioners were retrieved. They were briefed about the research's objectives and contents prior to beginning the survey. To avoid confusion while asking and filling out the questionnaire, questions were reviewed before to data collection.

3.6.2. Qualitative Data Collection Methods

A) Key Informant Interview:

The key informant interview was done with the aim to facilitating open interaction amongst key informants who can provide essential, complete, and detailed information. Face-to-face interviews were used for this. In accordance with this, informants were chosen based on their long-term experience, responsibility, expertise, involvement, and understanding of the topic and in one way, this supplemented the data's quality and trustworthiness.

The researcher conducted all interviews from the directors, team leaders, and team coordinators of the three institutions (Addis Ababa Disaster Risk Management Commission, National Disaster Risk Management Commission and the Akaki Kaliti Sub City Disaster risk Management bureaus) with the goal of conducting further investigation based on the

information provided by the respondents. The interviews had helped in gathering data on the institutional collaboration on the flood risk management.

B) Direct Observation:

During the household surveys, observations were carried out in order to improve the data from the other methods obtained. Observations were made during the filling of the Interview questionnaire to assess the actual situation of the flood prone areas in the sub city. Therefore, observation was used for this study as a tool for data gathering. From the observation, it was possible to take into consideration about the settlement and vulnerability of households, and the existed flood management practices.

C) Document Review:

The document reviews were including both from public and private sources. The public documents were plans, implementation reports, manuals, task force discussion minutes and reports. On the other hand, Private documents could be books and journal articles. Overall, to make this research more valid, credible and appropriate, secondary sources were employed in a comprehensive manner.

The major sources of the documents for review were the documents of National Disaster Risk Management Commission, Addis Ababa National Disaster Risk Management Commission (AADRMC) and, Akaki Kaliti Sub City Disaster risk Management bureau. With this in mind, any vital and reputable online sources were reviewed intensively in order to come up with sounding policy roundtable output of a good reputation.

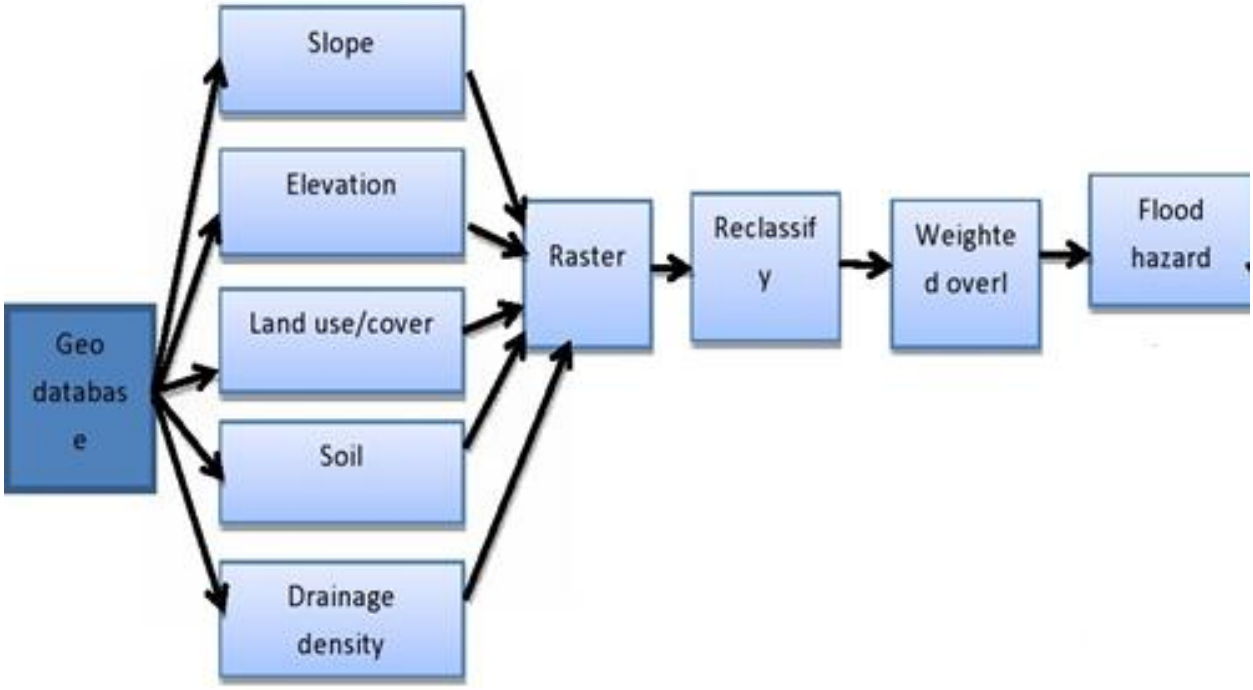
3.7. Methods of Data Analysis

To analyse the data collected from the primary and secondary sources; the study used both qualitative and quantitative data analysing methods. Particularly with the quantitative data's are collected via the questionnaire, a descriptive statistical analysis method and SPSS were used to tabulate the data and present it in tables. Statistical tools like frequencies, percentage method, mean and standard deviation uses to analyze data. Moreover, to analyze the data obtained through interview descriptive qualitative method of data analysis were employed. The summarized data analyzed to arrive at a meaningful conclusion and to come up with valuable recommendations. The researcher used IBM SPSS (Statistically Package for Social

Science) software; version 20 to analyze the quantitative data was collected from the questionnaire.

Flood risk hazard map was done by using GIS. Landsat Images were image enhancement and mosaicked to generate a composite which was then clipped to extract the area of study. The clipped image was subjected to maximum likelihood supervised classification to generate LULC classified maps. All these processes were performed in ArcGIS 10.8. Therefore, the flood risk map which can be reclassified into five zones, very high, high, moderate, low and very low zones. The general workflow showing the methodology to delineate flood risk area explained in the Figure 3-6.

FIGURE 3-6: Methodological flow of GIS analysis



Source: Own construction

3.8. Validity and Reliability

3.8.1. Validity

The extent to which differences observed with a measuring instrument represented genuine differences among those being tested called validity (Kothari, 2004). Validity is the most important criterion and reflects the degree of measurement by the instrument. For this study to validate the instruments, the researcher ruled out any ambiguous, confusing, or badly ordered questions, as well as the instruments were used to ascertain their validity and applicability, by revising as per respondents understanding in collecting the requested data.

3.8.2 Reliability

The accuracy and precision of a measurement procedure are related to its reliability. Kothari (2004) states that reliability is the capacity to exercise both reliably and accurately the responsibilities suggested.

All attributes of reliability dimension measures the level of implementation of flood risk management practices. To ensure the reliability of the instrument, the questionnaire was review by the supervisor and pilot test was carried out, and based on the feedback, instrument was modified to ensure item total statistics Cronbach's Alpha (α) would fall more than 0.7. As a result, the Cronbach's alpha results of the questionnaires are shown in the tables below.

TABLE 3-5: Cronbach's Alpha table for each item

	Cronbach's Alpha	**No of Items**
The overall assessment of FRM in Addis Ababa	.730	4
Challenge on FRM practice	.791	11
FRM activities on prevention and mitigation	.814	9
FRM activities on emergency preparedness and risk reduction	.845	8
FRM activities on emergency response	.902	10
FRM activities on rehabilitation and recovery	.823	10
prevention and adaptation measures to reduce flood losses	.916	11
factors that aggravate flood losses in Akaki Kality,	.744	8
Serious negative consequences of flood risk	.893	13
N of sample population		**84**

Source: SPSS output data (2021)

Generally, the overall Cronbach's alpha result of the questionnaires were shows on the following table.

TABLE 3-6: Cronbach's Alpha result of the questionnaires

Reliability Statistics	
Cronbach's Alpha	**No of Items**
.894	84

3.9. Ethical Consideration

Permission to conduct the research and an authorization letter to the sample households and organizations were obtained from the Addis Ababa University, which explaining to the respondents why the research being conducted and enhanced the confidentiality of the data collected from them, including the sample organizations and households under study.

The questionnaires were self-administered, data collected in person after meeting with the relevant person and being told on the goal of the research, expected duration and procedures and any potential research advantages. Understand confidentiality constraints such as data coding, disposal, sharing, and archiving, as well as when confidentiality must be compromised. Within five weeks, the questionnaires were Distributed and collected (four weeks for experts and one week for households). This ensured to obtain valid and reliable data from all respondents because they have adequate knowledge food risk management.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND INTERPRETATIONS

4.1. Introduction

This chapter contains findings on study of the flood risk management system practice in Addis Ababa and Akaki Kality Sub city as well. The findings have been discussed under thematic areas and subsections corresponding to the variables and objectives of the study. All questioner contexts focuses in flood risk management on (1) prevention and mitigation, (2) emergency preparedness and risk reduction, (3) emergency response, and (4) rehabilitation and recovery. These four areas are the key assessment areas of the study for flood management activities of Addis Ababa.

The data analysis and interpretation section of this thesis had three major components that were based on the study's objectives. The first objective (to identify flood hazards in Akaki Kality) was accomplished using GIS. This was done based on the combination of factors including slope, elevation, drainage density, rainfall, soil type, and land use. The delineate flood hazard map of case study area based on reclassified flood hazards. The reclassified risk map values between 1 and 5 were assigned after weighted overlay, where 5 indicates very high; 4 indicates high; 3 indicates medium; 2 indicates low; and 1 indicates that very low flood risk.

The second objective (to describe the practice of flood risk management) was done through a questioner's survey, which collected information from both sides of the governmental organizations working on DRM in Addis Ababa and from households in Akaki Kality Sub City. The responses collected from experts were through close ended questions and analized the analysis were done by using SPSS. However, the household responses were gathered through semi structure questionnaire.

Whereas, the third objective (to examine the practice of institutional collaboration) were done through face to face interviews. The thematic areas include study of demographic information, challenge that faces on the flood Disaster Risk Management; flood risk management practices on prevention and mitigation, emergency preparedness and risk reduction, emergency response and rehabilitation and recovery; effective prevention and adaptation measures; main factors that aggravate flood losses in Akaki Kality sub city; and questions related with institutional collaboration and linkages to manage flooding.

4.1. Questionnaire Response Rate

The total sample sizes of the study were 184. Out of the total sampled populations, 46 households were sampled from the community who lived in Woreda 03, Akaki Kality Sub city; and the rest 138's are experts from National Disaster Risk Management Commission, Addis Ababa City Administration Disaster Risk Management Commission and Akaki Kality Sub City Fire and Disaster Risk Management office.

From 184 questionnaires distributed, 158 were retrieved, representing an 86 percent response rate appropriate for the purpose of the study and sufficient for analysis, conclusion, and recommendation. According to Mulugeta (2003), a return rate of 50% is considered adequate, 60% is good, and 70% and above is very good. The researcher made calls and visits to request the respondents to fill out questionnaires and return them. Table 4.1 shows a summary of the total response rate.

TABLE 4.1: Summary for response rate

	Responses from Households	**Responses from Experts**	**Total**	**By Percent (%)**
No. of scattered questionnaires	46	138	184	100%
No. of retrieved questionnaires	36	122	158	86%
No. of Unreturned Questionnaires	10	16	26	14%

Source: Own analysis

4.2. Demographic characteristics of the respondents

The demographic characteristics of the respondents were investigated in the first section of the questionnaire. Respondents from three different government institutions and communities who live in Woreda 03, Akaki sub-city were participated in this survey to obtain accurate feedback on flood risk management system. The questionnaire was taken from two different demographic characters, so the demographic characteristics of the institutions and the households were kept separate.

The demographic characters of the three institutions were captured gender, age, educational qualification, years of experience and positions of the respondents. It has also captured the respondents' knowledge on preparedness, early warning, response and recovery.

4.2.1. Demographic characteristics of the Expert respondents

TABLE 4.2: General Background of Expert Respondents

	Demographic Data	Frequency	Percent
Organization	AAFDRMC	77	55.8
	NDRMC	36	26.1
	AKFDRMC	25	18.1
	Total	**138**	**100.0**
Gender	Male	73	59.8
	Female	49	40.2
	Total	**122**	**100.0**
Age	20-30	53	43.4
	31-40	44	36.1
	41-50	25	20.5
	Total	**122**	**100.0**
Experience in current organization	0-5	27	22.1
	6-10	52	42.6
	11-15	29	23.8
	15 and > 15	14	11.5
	Total	**122**	**100.0**
Educational Qualifications	Diploma	8	6.6
	BA/BSC	82	67.2
	Masters	32	26.2
	Total	**122**	**100.0**
Position	Team Leader	34	27.9
	Senior Expert	41	33.6
	Expert	41	33.6
	Other	6	4.9
	Total	**122**	**100.0**

Sources; Survey questioner (2021)

As shown in table 4.2 above 55.8 % of them were from Addis Ababa Fire and Disaster Risk Management Commission, 26.1 % from National Disaster Risk Management Commission, and 18.1% were from Akaki Kality Fire and Disaster Risk Management Commission.

The composition of the respondents by gender, 59.8 percent were male while 40.2 percent were female. This indicates that the dominant number is males consisting near to 60% of staff

working in different positions and this is the result for most of the respondents of the study are males.

The age distribution of the respondents on the table 4.2 also shows that 53 (43.4%) were between the ages of 20-30 years, 44 (36.1%) were between 31-40 years, and 25 (20.5%) were between 41-50 years. 43 % of the respondents are between the ages of 20-30 years. Thus the study found that the majority of staff members of three organizations were young.

The distribution of respondents indicates in table 4.2 above that 22.1% of the respondents have below 5 years of experience, 42.6% of the respondents are between 6-10 years of experience, 23.8% of respondent have 11-15 years of experience and 11.5% of respondent has over 15 years of experiences in their current organization. To conclude that 95 or 77.9% of respondents have served their current organization for more than 6 years and the number of years was capable to provide credible information related to the study. The distribution educational status of respondents tells us 67.2% have bachelor degree, 32% have master's degree and 8% of respondents have diploma.

As shown on the above table, only 8% of the respondents have diploma education level. The remaining 92% are of university graduate backgrounds. Therefore, the employees from the three organizations were educated well enough to understand and response the questions.

Table 4.2 shows that respondents' position on their current organization distribution shows that 34 (27.9%) of respondents were team leaders, 41 (33.6%) senior experts, 41 (33.6%) were experts and 6 (4.9%) were coordinators and officers.

As shown on the above table 4.2, out of 122 respondents senior and medium level experts were 82 (67.2%). And 34 (27.9%) of respondents were team leaders. The findings indicated that experts and Officers are highly involvement in flood risk management activities.

Based on various literatures reviewed flood risk management practice includes four major parts (preparedness, early warning, response and recovery). There the study assesses the respondents' knowledge about Flood preparedness, early warning system, flood risk response and recovery plans.

TABLE 4.3: Respondents knowledge on preparedness, early warning, response and recovery

	N		VG	G	P	VP	Mean	Std. Dev
Flood preparedness	122	Frequency	42	43	27	10	3.19	1.381
		Percent	34.4	35.2	22.1	8.2		
Early warning	122	Frequency	56	43	14	9	4.07	1.030
		Percent	45.9	35.2	11.5	7.4		
Response	122	Frequency	58	52	8	4	4.09	1.060
		Percent	47.5	42.6	6.6	3.3		
Recovery	122	Frequency	22	47	33	20	3.48	0.964
		Percent	18	38.5	27	16.4		

Source: SPSS output data (2021)

***VG**= Very Good* ***G**= Good* ***P**= Poor* ***VP**= Very poor*

On the above table 4.3, respondents were asked whether they have knowledge about major components that were necessary to assess flood risk management system. Therefore, respondents were asked their knowledge about flood preparedness, early warning, response and recovery. Thus their response shows that the majority of respondents have a very good knowledge to the statement 'Your knowledge about early warning system'; 'Your knowledge about flood response' in the mean of 4.07 with standard deviation of 1.381 and in the mean of 4.09 with standard deviation of 1.060. regarding with the statement 'Your knowledge about flood preparedness' and 'Your knowledge about recovery', the respondents have good knowledge in the mean score of 3.19 with standard deviation of 1.381 and in the mean of 3.48 with standard deviation of 0.964. Therefore, the respondents from the three institutions have enough knowledge to respond the questions related to flood risk management systems.

4.2.2. Demographic characteristics of the Household respondents

TABLE 4-4: General Background of Household Respondents

	Demographic Data	Frequency	Percent
Position in the household head	Male house hold	12	33.3
	female house hold	24	66.7
	Total	**36**	**100**

No of people living within your house	1 person	1	2.8
	3 persons	3	8.3
	4 persons	7	19.4
	5 persons	17	47.2
	6 persons	8	22.2
	Total	**36**	**100.0**
Education level of household head	Below matriculation	8	22.2
	Basic reading and Writing	4	11.1
	Elementary	6	16.7
	Secondary School	5	13.9
	Collage and above	13	36.1
	Total	**36**	**100.0**
Occupations	Retired	7	19.4
	Own Business	8	22.2
	Private Sector	2	5.6
	Public Sector	9	25.0
	Jobless	10	27.8
	Total	**36**	**100.0**
Households duration on the study area	< 1 year	4	11.1
	6-10 years	4	11.1
	11-15 years	11	30.6
	>16 years	17	47.2
	Total	**36**	**100**

Source: SPSS output data 2021

As shown on the above table 4.4 above, the composition of the head of the households by gender, 24 respondents or (66.7 percent) were females and 12 respondents (33.3 percent) were male head. In this study the number of female house head is higher than Male head; this is due to that the study was conducted from house to house and because I met women at home at the time.

The household's size ranged from 1 to 6 persons were assessed and the majority (47.22%) of respondents had 5 household members, 22.22% had 6 members, 19.44% had 3 household members and 2.8% or 1 respondent response were goes to 1 household member. Therefore, the result shows that the increasing family size member increases the number of flood victims.

As per the educational background of the household respondents of this study shown in the table 4-4 above, Out of the total sampled households, most of the respondents were college

and above 36.11% followed by below enrolment 22.22%; elementary school 16.67%; secondary school 13.89%; and basic reading and writing by 11.11%.

As shown in the Table 4-5 below, if we divide the education level of the households by gender, the illiteracy rate for women is 33.3% and for men it is only 12%. With regard to the higher education, 12.5 percent of women graduate from college and above and 50 percent of men, which shows that the number of educated male head in this study is much higher than that of Female heads.

TABLE 4-5: Educational level of household heads by gender

Educational Level	Male-Headed HH (%)	Female-Headed HH (%)
Below matriculation	16.67	33.33
Basic Read and write	4.33	16.67
Elementary education	13	25
Secondary education	16	12.5
Collage and Above	50	12.5

Source SPSS output Data (2021)

The distribution of job occupation of respondents indicates in table 4-4 that 19.4% of the households have retired, 22.2% of the households have run their own business, 5.6% of respondents are works on Private sector, 25% of household's works in public sector and 27.8% of the total respondent households were jobless.

Differentiating this result by gender, 20.8 percent of women female households are retirees and 16.7 percent of male households are retirees. On the other hand, 50 percent of male headed households are self-employed, while only 8.3 percent of female heads are self-employed. The study also shows that 41 % of female heads have jobless (see table 4-6).

TABLE 4-6: Job Occupation of the Household Respondents by Gender

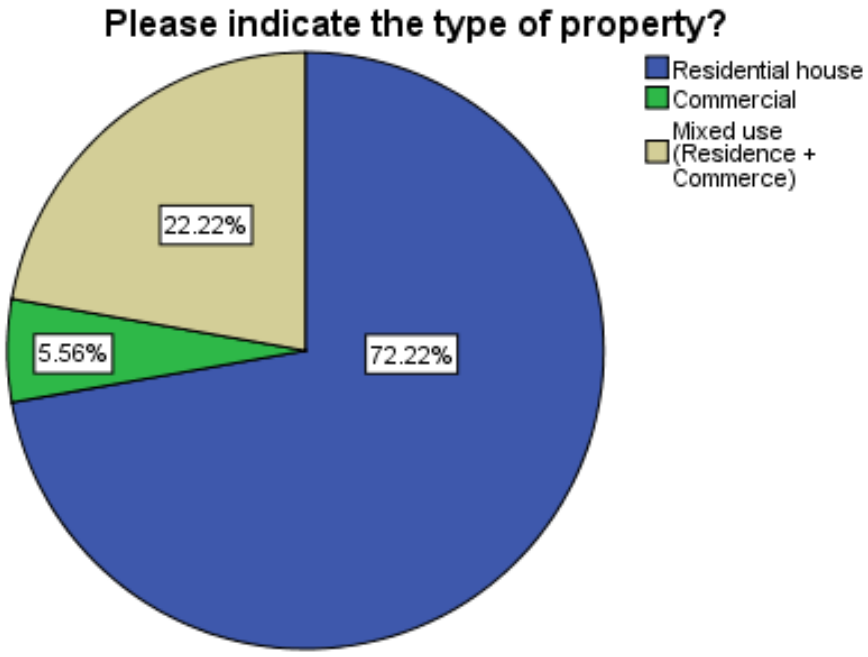
Occupations	Male Headed HH (%)	Female Headed HH (%)
Retired	16.7	20
Own Business	50	8.3
Private Sector	16.7	-
Public Sector	16.7	29.2
Jobless	-	41.7

Source: SPSS output Data (2021)

As shown on the table 4-4, 47.22% of household respondents were lived more than 16 years on the study area, 30.56% of respondents lived between 11-15 years, and 11.11% of respondents lived 6 to 10 years respectively. To illustrate, 77.78% of household respondents have been in the area for more than 11years, and have sufficient knowledge to respond to flooding management system.

Most of Household respondents who participated in the survey resided on the study area, and 72.22 percent of the total respondents indicated that they had a home. It is followed by 22.22 percent who had home and business and 5.56 percent who had businesses (see figure 4-1).

FIGURE 4-1: Property type of the household respondents on the site



Source: SPSS output, 2021

Respondents were asked if and where they were affected by the floods, with 94.4% of respondents saying that flooding had occurs inside of their homes, 83 % around their home, 66% on the street, 66.7% in the open area, and 83% on floodplains. They have confirmed that they have been affected. This mainly indicates that the area as a whole is highly flooded (see table 4-7).

TABLE 4-7: Areas were affected by the flooding

		Yes	No	Total
Inside of the residence	Frequency	34	2	36
	Percent	94.4	5.6	100
Compound of the residence	Frequency	30	6	36
	Percent	83.3	16.7	100
The street	Frequency	24	12	36
	Percent	66.7	33.3	100
Playground/open areas	Frequency	24	12	36
	Percent	66.7	33.3	100
Drainage lines	Frequency	30	6	36
	Percent	83.3	16.7	100

Source: SPSS output Data (2021)

As shown in Table 4-8 below, household respondents lived in Woreda 03, Akaki Kaliti Sub-City, were asked about the cause of the floods in their compound and their response was by heavy rain fall 63.9%, by the overflow of drainage line 44.4%, from nearside river 100%, Runoff from highland areas 41.7%, from runoff from street 47% and from neighbours gutter during rain 38.9%.

The table below shows that all households are affected by the floods. The households said they would be affected by the Akaki River and by heavy rain from the up streams. In addition to this, they would be at risk of flooding due to the filling of the Gefersa Dam. Gefersa reservoir is one of the surface water sources that provide clean drinking water to residents of Addis Ababa. The Geffersa catchment area is .56 km2 or 5,556 ha and is managed by AAWSA. During rainy seasons the Gefersa dam were filled by water and sometimes the water were released and affects the community.

TABLE 4-8: Major reasons for flooding

		Yes	No	Total
Heavy rain fall	Frequency	23	13	36
	Percent	63.9	36.1	100
The overflow of drainage line	Frequency	16	20	36
	Percent	44.4	55.6	100
Nearside river	Frequency	36	0	36
	Percent	100	0	100
Runoff from highland areas	Frequency	15	21	36
	Percent	41.7	58.3	100
Runoff from street	Frequency	17	19	36
	Percent	47.2	52.8	100
Neighbours gutter during rain	Frequency	14	22	36
	Percent	38.9	61.1	100

Source: SPSS output Data (2021)

3.3. Identification of flood risk areas in Akaki Kality sub city

Flood risk areas identification could include an assessment of the risk of flooding from all flooding mechanisms, the identification of flood mitigation measures, and advise on actions to be done before and during a flood.

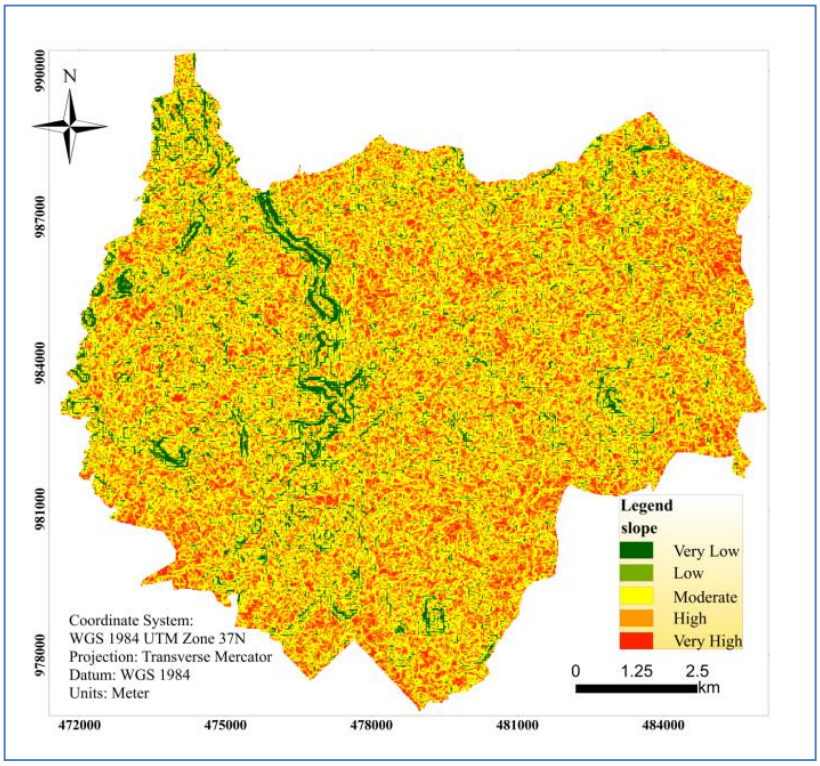
The major causes of floods include intensity, duration and spatial distribution of rainfall on catchments; sedimentation on river channels and overflow of water from the riverbanks; steep slopes, deforestation and poor soil infiltration capacity; failure of hydrologic structures and sudden release of waters from dams; and landslides. These factors influence the magnitude, run-off or velocity of the flood and increase the risk of flood damage. The major factors for this study was Slope, rainfall, elevation, drainage density, LULC and soil.

4.3.1 Slope Factor

Slope has a great influence on flood hazard. The flatter the slope, the more likely the area will be flooded. Slope of the study area was derived from 30 m resolution digital elevation model. The slope raster layer was further reclassified in five sub group using standard classification schemes namely Quintiles. In addition, new values were assigned in the order of flood hazard rating.

The reclassified slope is given a value 1 to 5 with the higher value,5 showing high influence in resulting very high flood rate, while the lower value,1 showing very low influence in resulting very low flood rate. Therefore, an area with very low slope is ranked as 5 and an area with very high slope is ranked as 1.

FIGURE 4-2: Slope factor map of the study are

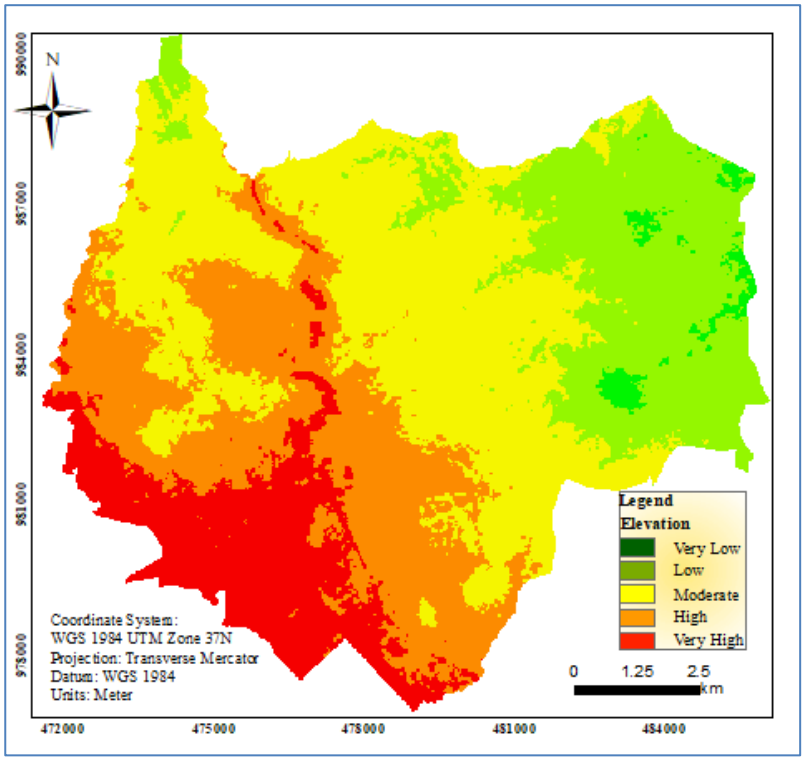


4.3.2 Elevation Factor

Elevation of the study area was generated from 30m Digital Elevation Model downloaded from USGSS. The elevation raster layer was further reclassified in five sub groups using standard classification schemes namely Equal Interval. New values re-assigned in order of flood hazard rating.

In this classification process, an area at the lowest elevation is severely affected by flooding and thus ranked 5 whereas an area at a relatively higher elevation is least affected by flooding and thus ranked 1.

FIGURE 4-3: Elevation factor map of the study area

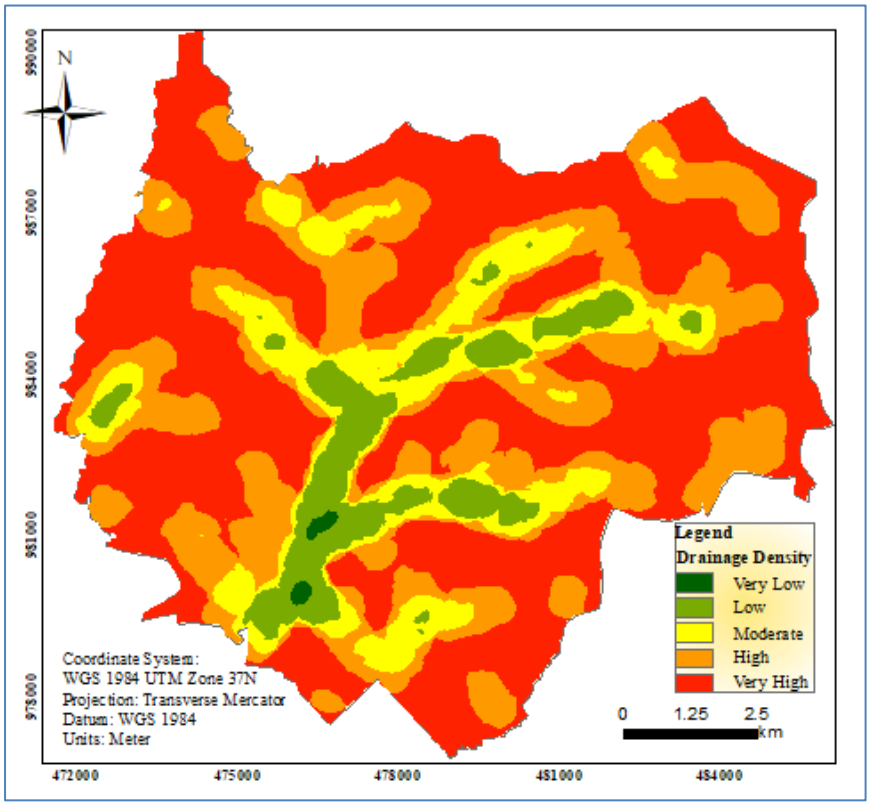


4.3.3 Drainage Density Factor

The drainage of the study area is derived from DEM using hydrological analysis. The density layer is further reclassified in five sub group using standard classification schemes namely Equal Interval.

The drainage density is given a value 1 to 5 with the higher value,5 showing high influence in resulting very high flood rate, while the lower value,1 showing very low influence in resulting very low flood rate. Therefore, an area with very low drainage density is ranked as 5 and an area with very high drainage density is ranked as 1.

FIGURE 4-4: Drainage density factor map of study area

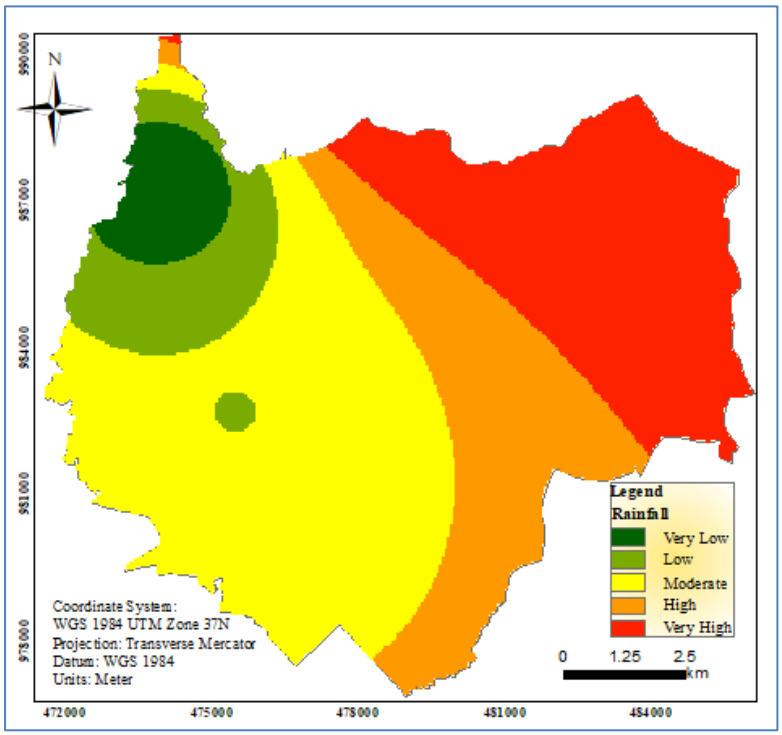


4.3.4. Rain fall factor

The rainfall data was collected at six stations within and out of the study area. The data received is of 30 years of monthly total rainfall. From this data annual average was calculated for each station then interpolated to Inverse Distance Weight (IDW) and then converted to raster layer which was finally reclassified into five classes using Equal Interval.

The reclassified rainfall is given a value 1 to 5 with the higher value,5 showing high influence in resulting very high flood rate, while the lower value,1 showing very low influence in resulting very low flood rate. Therefore, an area with very high rainfall is ranked as 5 and an area with very low rainfall is ranked as 1.

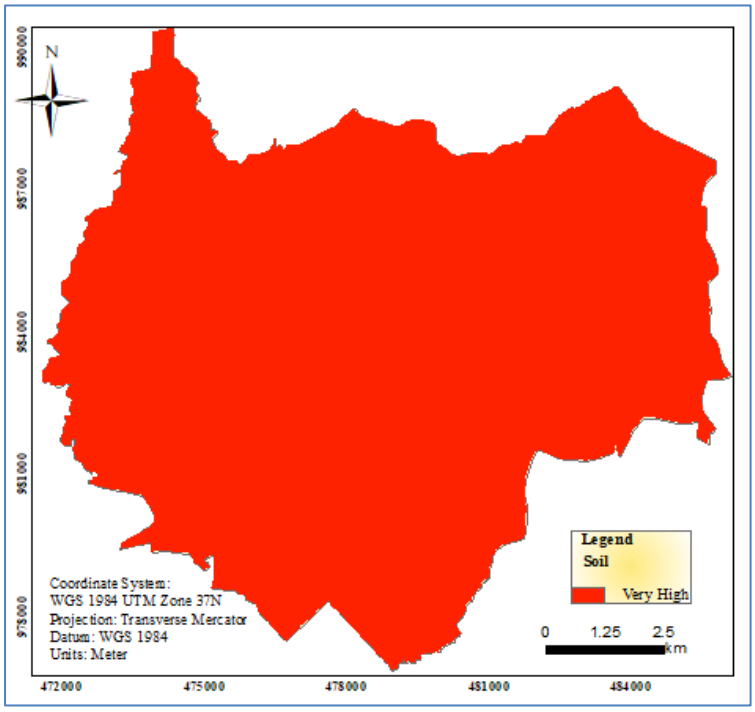
FIGURE 4-5: Rainfall factor map of the study area



4.3.5 Soil Factor

As the data collected from ministry of Agriculture with 250m resolution, major soil types in study area was Vertisols. This soil is churning, heavy clay soil with a high percentage of swelling clays.

FIGUR 4-6: Soil factor map of the study area



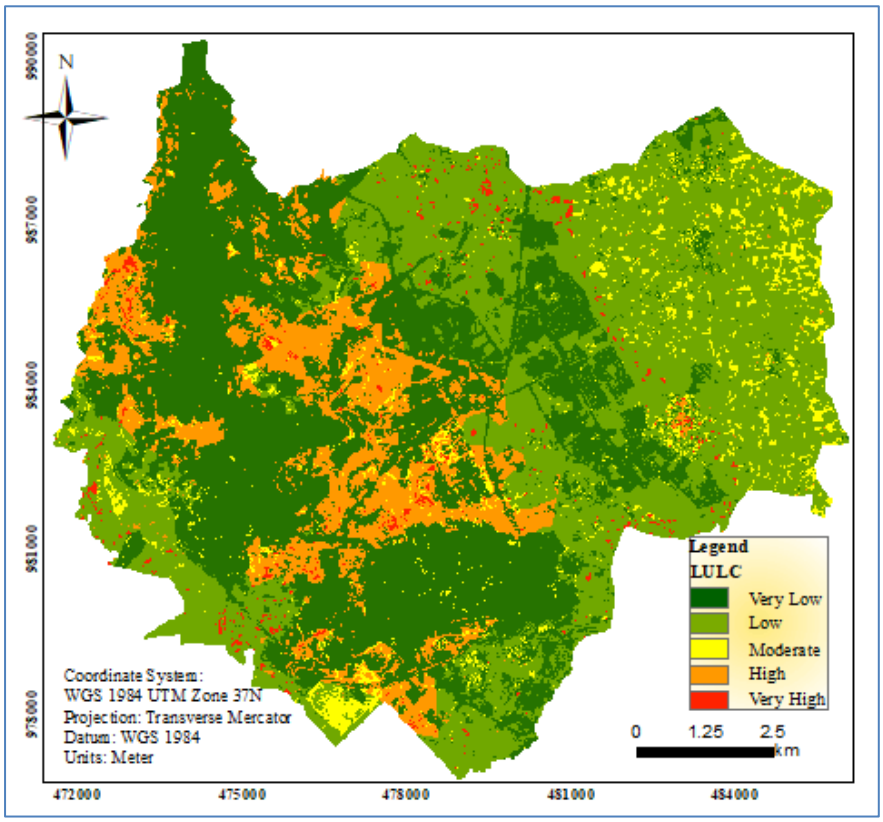
These soils form deep wide cracks from the surface downward when they dry out, which happens in most years. Vertisols, which dominate the whole area of the study area, are imperfectly drained to poorly drained, deep, very dark grey to greyish brown, mottled firm clay soils so that are given the highest scale in the flood hazard rating.

4.3.6 LULC factor map

Land use land cover map of the study area was produced from 2020 Landsat image using the supervised method of image classification. The major LULC type of the study area were wetland, bare land, forest, shrub land, built up, water body, farmland and grass land. The existing land use type of the area was reclassified into five groups in order of their capacity to increase or decrease the rate of flooding.

Accordingly, Water body and wetland land use type has the capacity to increase flood rate in the area, and hence, is ranked to 5, farm land and bare land is ranked to 4, grass land is ranked to 3, shrubs is ranked to 2 and forest land and built up has very low capacity to generate flood and is ranked to 1. Thus, new values reassigned in order of flood hazard rating for hazard analysis.

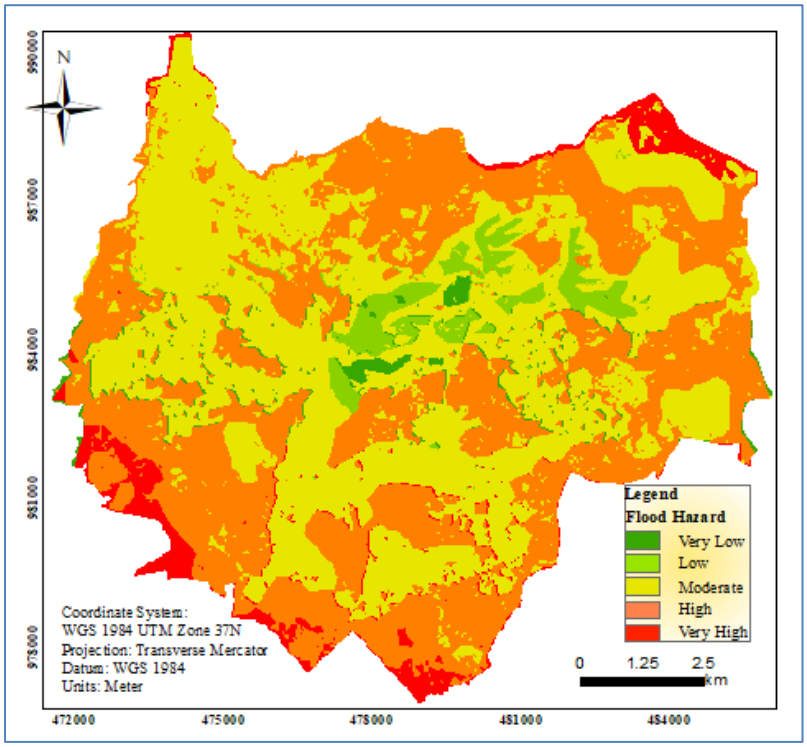
FIGURE 4-7: LULC factor map of the study area



4.3.7. Flood Hazard Analysis

Flood hazard analysis was done by computing weighted overlay of rainfall, drainage density, slope, soil, land use, and elevation factors. The final hazard map of the study area was shown as Figure 4.8.

FIGURE 4-8: Flood hazard map of the study area



As Shown on table 4.9 below, From the flood hazard map (Figure 4.8), produced by weighted overlay of the six reclassified causative factors (i.e. rainfall, drainage density, slope, elevation, soil and land use) the flood hazard zones are calculated to be 44 % of the total area were subjected to high to very high flood hazards; while, 56 of the area were subjected to very low to moderate level of flood hazards.

TABLE 4.9: summary of flood hazard

No	Area/km	Hazard	Percentage
1	2.055333	Very Low	2
2	4.50983	Low	7
3	55.03574	Medium	47
4	50.73823	High	40
5	5.824914	Very High	4
Total	**119**		**100**

4.4. Descriptive Analysis

The responses were generated on a five-point Likert scale; 5= strongly Agree/ Very effective/ Very Responsive/ Very Efficient, 4= Agree/ effective/ Responsive/ Efficient, 3= Neutral/ Moderately effective/ Moderately Responsive/ Efficient, 2= Disagree/ slightly effective/ Responsive/ Slightly Efficient and 1= strongly Disagree/ Not effective/ Not Responsive/ Not Efficient. The respondents were required to state their level of agreement or disagreement. To determine the minimum and the maximum length of the 5-point Likert type scale, the range is calculated by (5 − 1 = 4) then divided by five as it is the greatest value of the scale (4 ÷ 5 = 0.80). Afterwards, number one, which is the least value in the scale, was added to identify the maximum of this cell. The length of the cells is determined below based on traditional way and if mean score from 0.01 to 1.00 is (strongly disagree); from 1.01 to 2.00 is (disagree); from 2.01 until 3.00 is (neutral); 3.01 until 4:00 is (agree) and score from 4.01 until 5.00 is (strongly agree).

4.4.1. Descriptive Analysis on the flood risk management practice in Addis Ababa

In general, the raw data were collected from 122 experts working on DRM institutions in Addis Ababa and from 36 household members living in Akaki Kality Sub-City respectively. The total number listed in the table (described as N==122) only shows the number of the experts; this is due to the fact that the questionnaires provided to the experts were easy to convenient using SPSS and the questions were prepared using the licker scale.

On the other hand, the data gathered from households was prepared with open-ended questions because the responses expected from the households broadened the scope and made it easier for them to explain their opinions on flood risk management systems. In addition, some questions were deemed unsuitable for gathering information from households and required the knowledge of experts, so the questions were only viewed by experts. On the other end of the spectrum, there was an attempt to explain the response from both sides to questions that were not the same.

In order to assess the flood risk management practice in Addis Ababa, respondents were provided with four queries on the prerequisites emergency management cycles. The summary data is presented below with the responses in table 4-10 and the analysis subsequently.

Accordingly, the primary section in the category is intended to assess the overall flood risk management practice of the three institutions at different emergency management cycles (prevention and mitigation, preparedness and risk reduction, emergency response, rehabilitation, and recovery).

TABLE 4-10: Overall assessment of Flood Risk Management practice in Addis Ababa

Concerning Areas	N	Mean	Std. Deviation
The overall assessment of Flood Risk Management in Addis Ababa on the prevention and mitigation period	122	2.88	1.154
The overall assessment of Flood Risk Management in Addis Ababa on the preparedness and risk reduction	122	1.98	0.953
The overall assessment of Flood Risk Management in Addis Ababa on the emergency response	122	3.02	.996
The overall assessment of Flood Risk Management in Addis Ababa on the rehabilitation and recovery period	122	2.04	1.131
Average		**2.48**	**1.0585**

Source: SPSS output Data (2021)

NB:5=*Very effective* ***4=****Effective* ***3=****Moderately Effective* ***2=****Slightly Effective* ***1=****Not Effective*

On the above table, respondents were asked whether the overall flood risk management practice in Addis Ababa on the prevention and mitigation period is effective or not and the majority of the mean score (mean 2.88)of them confirmed by neutral that prevention and mitigation on flood risk management are slightly effective. This indicates that prevention and mitigation activities in Addis Ababa on flood risk management practice are not well functioning. On the other hand, the data gathered from the household's shows that the flood risk management system is not effective in preventing floods, especially due to the lack of early warning, which makes the disaster prevention process ineffective. Overall, the study showed some differences between experts and the household's responses. It can be seen from the fact that some households are being given a replacement and it will be partially effective for future flood risk reduction.

Regarding the overall assessment of Flood Risk Management in Addis Ababa on the preparedness and risk reduction, the majority of the respondents (mean 1.98) have disagreed. Therefore, it can be inferred that the flood risk management during preparedness and risk reduction phases in Addis Ababa was not practiced effectively. In this regard, the household

respondent's responses shared the idea of experts especially on the preparedness, they disagreed that there was a good preparedness system.

As shown in the above table 4-10, responses to the overall assessment of flood risk management in the emergency response have a mean score value of 3.02 with a standard deviation of .996 which implies the three DRM organizations have well-practiced emergency response activities. This means having effective flood risk management in the emergency response will help to decrease the volume of damage and impact of the flood on the environment.

Regarding the overall assessment of Flood Disaster Risk Management in Addis Ababa on the rehabilitation and recovery period, both respondents from the households and from the three government institutions were neutral in the mean of 2.04 with a standard deviation of 1.131. The results demonstrated the DRM institutions the rehabilitation and recovery practices have been Slightly Effective. In this regard, the information gathered from household respondent's shows, government support is very limited and does not cover all quantity of the damages caused by a flood.

The overall mean dimension is 2.48 Thus it indicates that overall the respondents assessed the flood risk management practice in Addis Ababa as slightly effective from the perspective of prevention and mitigation, preparedness and risk reduction, emergency response, and rehabilitation, and recovery.

TABLE 4-11: Challenge that faces on the flood risk management practice

Challenges	N	Mean	Std. Deviation
Financial/ budget scarce	122	3.36	1.206
Political intension/will (Leadership)	122	3.70	1.465
Awareness	122	3.84	1.227
Level of Community engagement	122	4.01	1.079
Lack of disaster management plan	122	3.51	.998
Inconsistency in disaster management planning between top-down and bottom-up	122	4.05	1.040
Lack of coordination across the disaster management cycle (mitigation, Preparedness, Response and recovery)	122	3.78	1.000
Low capacity (Manpower)	122	3.73	1.021
Insufficient support from National Government	122	3.77	1.027

Lack of coordination between Local government units , Non-government organizations, & other agency	122	3.08	1.551
Average		**3.73**	**1.144**

Source: SPSS output Data (2021)

***NB: 5**=Strongly Agree **4**=Agree **3**=Moderately Agree **2**=Disagree **1**=strongly disagree*

Participants were asked to confirm on their organization if financial/ budget scarce is considered as a challenge that faces on the flood risk management practice (mean 3.36) respondents agreed. Lack of funds for flood risk management activity was a major challenge for flood risk management practice.

With related to the Political intension/will in the aspects of organizational leadership to manage flood risks has a mean score value of 3.70 with a standard deviation value of 1.465 which indicates the leadership willingness to manage flood hazard in the DRM organizations rising problem and makes FRM activities difficult. FRM should be the responsibility of all levels of government and those who live, work, or influence activity in flood risk areas. Therefore leadership of flood management requires a leader who can distinguish activities that facilitate effective operations and take steps to ensure that they are given continuous attention.

As shown on the above table 4-11 the awareness about flooding hazard in disaster management practice has a mean score value of 3.84 with a standard deviation value of 1.227. Awareness and preparedness can increase an effective response in flood management and becoming key issues to be considered for effective emergency planning and management. However the respondent's response agreed that awareness is considered as a major challenge on FRM which indicates that awareness creates troubles on effective DRM practices.

With related to the community engagement level on flood risk management practice respondents response in the mean of 4.01 indicates that the majority of respondents were strongly agree that they encounter problems in the community participation. Public participation is a mandatory since information; consultation; and active involvement are required. However, In Addis Ababa context the community participation is very low on flood risk management systems.

Concerning whether the organization has inadequate disaster management plan the mean value was 3.51 with standard deviation .998 which imply those three DRM organization has lack of disaster management plan in their flood risk management system. Disaster management plan can be a preventative plan prepared to reduce the damages occurred by disaster like flooding. It must be prepared before the occurrence of flooding so as it helps the organizations minimize the waste of time and resources that are all too precious after flooding. However, based on the respondent's response there is luck of disaster management plan and it implies that those three DRM institutions can't respond efficiently on flooding management practices.

The mean value of inconsistency in disaster management planning between top-down and bottom-up on FRM activities 4.05 with standard deviation of 1.040 which implies those organizations has a lack of consistency on top-down (government led the approach whereby local governments and communities may not involve in decision-making processes) and bottom-up (starts the preparedness activity from the root level by consulting with the most flood prone peoples , the drawbacks they face from existing management).

As shown on the above table, the flood risk management practice has a lack of coordination across the disaster management cycle (mitigation, Preparedness, Response and recovery) in the mean value was 3.78 with a standard deviation value of 1.000 which indicates that the mitigation, Preparedness, Response and recovery activities are not well practiced on those three organizations.

Respondent's response to the human resource on flood risk management activities has a mean score value of 3.73 with a standard deviation value of 1.021 which shows that the existence of a low capacity of manpower in the flood risk management practices. The accessibility of qualified human resource to execute the mitigation practice is below what is expected to have an implication on the performance of the relief operation.

As shown on the above table 4-11, respondents has agreed that there is insufficient support from National Government in the mean of 3.77 with the Standard Deviation 1.027 which implies that the national government gives low priority and give insufficient support to the city DRM organizations.

Respondents response were agree for the question that if there is lack of coordination between local government units, Non-government organizations, & other agency in the mean of 3.08 with the Standard Deviation 1.551. This implies that there is luck of stakeholder collaborations in Addis Ababa. Coordination among DRM organizations helps to identify the responsible actors across government organizations and departments (Mofleh et al., 2009) and can result in harmonious task completion. However in Addis Ababa context there is luck of coordination between local government units, Non-government organizations, & other agencies.

TABLE 4-12: Flood risk management activities on prevention and mitigation

Concerning Areas	**N**	**Mean**	**Std. Deviation**
Hazard Mapping and urban planning are in place at all level of administration	122	1.99	1.205
Education, continuous trainings and awareness creation are given effectively	122	2.94	1.015
Institutions, individuals and volunteers are responsible for maintaining preparedness equipment's like Antibiotics and medical kits	122	1.99	1.079
Transportation which used to give service for flood affected peoples	122	2.70	1.365
Proactive community participation	122	2.43	.979
Infrastructure	122	2.39	1.072
In placing urban early warning systems	122	2.16	.909
Financial reserves and contingency mechanisms are in place	122	2.72	1.262
Does the community have an access to get emergency contacts	122	1.8	1.322
Average		**2.346**	**1.1342**

Source: SPSS output Data (2021)

***NB: 5**= Strongly Agree **4**= Agree **3**= Moderately Agree **2**= Disagree **1**= strongly disagree*

On the above table which contains nine categories respondents were asked to rate the flood risks management activities in their organizations in terms of prevention and mitigation. Based on this, the respondent's responses disagreed with the mean value of 1.99 with the statement that hazard Mapping and urban planning are in place at all levels of administration.

This implies that the communities did not get important information that helps them to understand the risks of flood hazards.

For education, continuous training and awareness creation are given effectively; the majority (mean 2.94) respondents moderately agreed that awareness creation and continuous training are given to the community. However, the household respondents were disagreeing with the expert's response. The households explain that sometimes some training was given for volunteers but at wide and community level, they did not receive flood-related awareness creation training.

As portrayed in the above table, a query was forwarded to respondents concerning the institutions, individuals and volunteers are responsible for maintaining preparedness equipment like Antibiotics and medical kits. Then, the mean value of 2.94 with a standard deviation of 1.079 implies that there were less responsibilities sharing of institutions, individuals, and volunteers with regard to maintaining the preparedness equipment.

On the subject of transportation which used to give service for flood-affected people's majority (mean 2.70) responses of the respondents were confirmed that there lack transportations to the DRM institutions in Addis Ababa.

Responses gathered from experts were confirms that to the items that there was less community participation in the mean score of 2.43 with a standard deviation of .979; unsuitable infrastructure like roads and traffic management in the mean score of 2.39 with a standard deviation of 1.072; no financial reserves and contingency mechanisms in the mean score of 2.72 with a standard deviation of 1.262 respectively.

Whereas, the respondent's response disagreed that communities have an access to get emergency contacts with a mean score of 1.8 and standard deviation of 1.322. It implies the vulnerability of communities was increased due to lack of access to get emergency contacts. In relation to this, the responses of household respondents were similar to the responses of experts to the above-mentioned items.

The overall mean dimension 2.346 indicates that the flood risk management system in prevention and mitigation is not activated well.

TABLE 4-13: Flood risk management activities on emergency preparedness and risk reduction

Concerning Areas	N	Mean	Std. Deviation
The existing institutions have efficient capacity to respond to mass loss	122	3.81	1.167
The communities are aware of the official warning and respond accordingly	122	2.51	1.194
Is the DRM organization adequately addressing flood risk management challenges in Addis Ababa?	122	2.40	1.257
There are well-defined standards in place for the provision of relief	122	1.99	1.032
Is there standardized reporting formats and analysis methods in place in the city?	122	2.82	1.128
Is there an evacuation plan in place for the vulnerable community?	122	1.89	.864
The training conducted at the community level?	122	3.19	1.167
The flooding awareness and public information programmes being undertaken to the community?	122	2.79	1.313
Average		**2.675**	**1.140**

Source: SPSS output Data (2021)

***NB: 5**= Very Responsive **4**= Responsive **3**= Moderately Responsive **2**=Slightly Responsive **1**= Not Responsive*

With related to the existing institutions have efficient capacity to respond to mass loss has a mean score value of 3.81 with a standard deviation value of 1.167 which indicates the organizations have available resources, strengths, and attributes to manage and reduce flood risks and strengthen resilience.

In contrast, the majority of respondents in the mean of 2.51 with a standard deviation of 1.194 were moderately responsive to the item that ‘the communities are aware of the official

warning and respond accordingly.' In this regard, the responses from the household respondents to this statement show that, despite the fact that early warning systems have been in place since last year and are not available at all levels of the community, the community takes preventive measures on its own. The response of the households also shows that when the Gefersa Dam is filled, the water will be released without warning and will enter their houses, causing damage to many of their properties.

The mean value of the adequacy of DRM organization with the aspect of addressing flood risk management challenges in Addis Ababa responses was 2.40 with a standard deviation of 1.257 indicates that there is a gap in addressing flood risk management challenges during emergencies preparedness and risk reduction. On the contrary, the responses of the households show that various measures have been taken in recent times to prevent floods; one of the measures taken was resettlements. Taking steps to relocate can help reduce the risk of flooding, but there were many obstacles that were unsatisfactory to the community. Even so, responses were weighted to indicate that the institutions are working to solve the problem, and it is possible to say that it is responsive.

Responses from the experts to the statement that 'The flooding awareness and public information programs being undertaken to the community?' were neutral in the mean of 2.79 with the standard deviation of 1.313 respectively. However, it is totally not responsive to the household respondents. According to the household respondents, some awareness and public programs are held in the hall to raise awareness of young volunteers, but not in the community.

As shown in the above table, in terms of flood risk management activities on emergency preparedness and risk reduction, the most of respondents responses have disagreed with the statement that 'there are well-defined standards in place for the provision of relief'; 'is there an evacuation plan in place for the vulnerable community?' in the mean of 1.99 with the standard deviation of 1.032 respectively. Evacuations are fundamental to avoid exposure to critical activities and temporarily shift individuals from flood-prone areas. Therefore the respondent's response indicates that there was an absence of an evacuation plan in Addis Ababa emergency preparedness and risk reduction and it worsen the flooding hazard in the study area.

TABLE 4-14: Flood risk management activities on emergency response

	N	Mean	Std. Deviation
Relief operation (Provide first aid, distribute clean up supplies like mops, gloves and tarps, Serve water and hot meals, Assess damage in impacted neighbourhoods etc)	122	2.75	1.263
Rescue	122	4.40	.840
Health service	122	3.61	1.048
Social support (emotionally, physically like money and housekeeping, and providing information to help others	122	3.34	1.365
Early recovery mechanism	122	3.07	1.300
Management of dead and missing	122	4.03	.979
Evacuation management	122	2.88	1.210
Social protection intervention	122	2.43	.691
Civil & uniformed services coordination	122	3.26	1.401
Average		**3.334**	**1.121**

Source: SPSS output Data (2021)

***NB: 5**= Very Responsive **4**= Responsive **3**= Moderately Responsive **2**=Slightly Responsive **1**= Not Responsive*

In this category, respondents were asked if relief operations like providing first aid, distributing clean-up supplies like mops, gloves, and tarps, assessing damage in impacted neighbourhoods are responsive or not and (mean 2.75) implies that the relief operations did not well practiced among those three DRM institutions.

In terms of flood risk management activities in emergency response in Addis Ababa, the majority of respondents' responses were strongly agree (mean 4.40) which implies the rescue of life's activity is well-practiced. Similarly, the respondent's response on the management of dead and missing (mean 4.03) implies Addis Ababa's flood risk management activities on an emergency response regarding the management of dead and missing's.

Although, the majority of experts respondents response were agreed to the items that 'health service' in the mean of 3.61 with the standard deviation of 1.048; 'social support

(emotionally, physically like money and housekeeping, and providing information to help others in the mean of 3.34 with the standard deviation of 1.365; 'early recovery mechanism' in the mean of 3.07 with the standard deviation of 1.3; and 'civil & uniformed services coordination'; in the mean of 3.26 with the standard deviation of 1.401 respectively.

Whereas, most of the expert's respondent's responses were neutral for the statement that 'social protection intervention' in the mean of 2.43 with the standard deviation of 0.691; and 'evacuation management' in the mean of 2.88 with the standard deviation of 1.21; and respectively.

In general, household responses were similar to experts' responses, citing some positive response factors that strengthened flood risk management. As part of their responses, helicopters were able to rescue flood victims and a variety of household items were provided.

The overall mean dimension 3.334 indicates flood risk management activities in Addis Ababa on emergency response are responsive.

TABLE 4-15: Flood risk management activities on rehabilitation and recovery

Concerning Areas	N	Mean	Std. Deviation
Livelihood for affected victims are in place	122	3.13	1.012
There is sufficient legislation and capacity in place to minimize negative environmental consequences	122	2.66	.788
A sector- wise recovery framework has been developed	122	2.36	.705
Shelter/ Relocation for affected victims	122	1.71	.848
Psycho Social Counselling	122	2.66	.678
Infrastructure and Relocation plan	122	1.61	.709
Post disaster need assessment	122	3.44	1.227
Environmental Protection	122	2.44	.693
Socio vulnerability maps available for the sub cities	122	1.97	.715
Average		**2.477**	**0.8304**

Source: SPSS output Data (2021)

***NB: 5**=Very Efficient **4**=Efficient **3**=Moderately Efficient **2**=Slightly Efficient **1**=Not Efficient*

As described in the above table 4-15, responses from experts to items under flood risk management activities on rehabilitation and recovery indicate that the majority of respondents' responses were agreed (mean 3.13) that livelihoods were in place for affected victims. The response from households to this item is similar to the response from experts, but the households were aware of some faults. Among those, some non-flood-affected communities pretended to be affected by the floods, flooding their homes with floodwaters and preventing them from receiving real help, and causing inadequate access to real help. However, they responded that it was effective. Although, the majority of experts respondents' responses were agreed to the items that post-disaster need assessment in the mean of 3.44 with a standard deviation of 1.227.

Although, the majority of expert respondents response was neutral to the item that the DRM institutions in Addis Ababa have sufficient legislation and capacity to minimize negative environmental consequences in the mean of 2.66 with the standard deviation of .788 which implies that the three DRM institutions don't have legislation power which allows them to enforce others with regard to minimize negative environmental consequences of flood risks.

Respondents were asked if there were a sector-wise recovery framework was developed on their organizations on the aspects of flood risk management and (mean 2.36) disagreed that sector-wise recovery frameworks were not developed.

As shown in the above table the responses from expert respondents were neutral to the items 'Psycho-Social Counselling' in the mean of 2.66 with the standard deviation of .678; 'environmental protection' in the mean of 2.44 with a standard deviation of .693 respectively.

Whereas, most of respondents response disagreed with the items that 'shelter/ relocation for affected victims' in the mean of 1.71 with a standard deviation of .848; 'infrastructure and relocation plan' in the mean of 1.61 with a standard deviation of .709; and 'socio vulnerability maps available for the sub cities' in the mean of 1.97 with a standard deviation of .715 respectively.

Although household respondents' responses were similar to the statements listed in this paragraph, a number of issues have been raised, one of which is the resettlement of residents. The people who lived there rented out their places and homes and ran various businesses, but

some refused to find alternative housing for fear of losing all of their benefits because they were given condominium houses. They also complained that the numbers of tenants in the area were greater than the number of landowners and that the settlement plan had not been incorporated the tenants.

TABLE 4-16: prevention and adaptation measures to reduce flood losses in Addis Ababa

	N	Mean	Std. Deviation
Development of forecasting and warning services	122	4.10	1.007
Inform the public about flood risks and their mitigation	122	4.09	.962
A water sensitive design	122	2.53	1.214
Create flood risk adapted land-use plans.	122	2.52	1.306
Heightening and strengthening the existing levees	122	3.20	1.277
Build dams, dikes and floodwalls	122	2.72	1.062
Develop disaster recovery plans	122	2.76	1.099
Provide financial provisions in case of disasters	122	3.04	1.417
Elaborate evacuation and rescue plans	122	3.16	1.357
Maintain the existing drainage systems	122	3.75	1.276
use of temporary flood barriers (e.g., sand bags)	122	3.30	1.251
Average		**3.197**	**1.202**

Source: SPSS output Data (2021)

***NB: 5**=Very Effective **4**= Effective **3**=moderately effective **2**= Slight effective **1**= Not effective*

As described in the above table 4-16, responses to items under prevention and adaptation measures that would be most effective for reducing flood losses in Addis Ababa indicates that the majority of respondents response were strongly agreed on the development of forecasting and early warning services in the mean of 4.10 with the standard deviation of 1.007 which implies the respondents from each DRM institutions agrees that flood hazard will decrease if flood forecasting and early warning are carried out in flood-prone areas.

Also, Query was forwarded to respondents regarding providing information to the public about flood risks (mean 4.09) responded that providing rapid access to information on flood risk were effective method that helps to prevention and adaptation measures to reduce flood losses in Addis Ababa.

Whereas, most of the responses were disagree with the items that 'A water sensitive design' in the mean of 2.53 with the standard deviation of 1.214; 'create flood risk-adapted land-use plans' in the mean of 2.52 with the standard deviation of 1.306; 'build dams, dikes, and floodwalls' in the mean of 2.72 with the standard deviation of 1.062; and 'develop disaster recovery plans in the mean of 2.76 with the standard deviation of 1.099 respectively. This implies that based on the respondents who work on the DRM institutions agreed that these four items may not have effect in the context of Addis Ababa as a to prevention and adaptation measures to reduce flood losses.

While concerning the improvement and strengthening of the existing levees (mean 3.20) agrees that it could be useful to reduce flood losses in Addis Ababa. Similarly, the respondent's response in the mean of 3.04 with the standard deviation of 1.417 agrees that the item providing financial provisions during flooding could be an effective method to decrease flood hazards.

Although, the majority of respondents response agreed to the items that 'elaborate evacuation and rescue plans' (mean 3.16); 'use of temporary flood barriers (mean 3.75)'; and 'maintain the existing drainage systems (mean 3.30)' respectively could be effective methods that help to prevention and adaptation measures to reduce flood losses in Addis Ababa.

TABLE 4-17: factors that aggravate flood losses in Akaki Kality, Addis Ababa

	N	Mean	Std. Deviation
Too many people live in flood risk areas	122	3.04	.991
Exposed people do not take sufficient measures to prevent losses	122	4.15	1.224
Levees have not been properly maintained	122	4.25	.914
The warning systems are not good enough	122	3.87	1.233
Flood risk management organisations do not have sufficient resources	122	4.03	.918
Climate change	122	3.78	.914
An origin of big rivers	122	4.15	.810
Deforestation	122	3.75	1.130

Average		**3.8775**	**1.040**

Source: SPSS output Data (2021)
***NB: 5**= Strongly Agree **4**= Agree **3**= Moderately Agree **2**= Disagree **1**= strongly disagree*

On the above table, respondents were asked that if densely populated living along flood-prone areas could aggravate flood losses in Akaki Kality and the mean score of 3.04 implies that the rising number of people living in flood-prone areas makes flooding hazards worse.

As described in the above table 4-17, responses to items under factors that aggravate flood losses in Akaki Kality indicates that the majority of respondents response were strongly agreed that exposed people do not take sufficient measures to prevent losses, the majority (mean 4.15), describes flooding was aggravated due to the negligence of the peoples living on flood-prone areas and their failure to take the necessary precautions.

For the query intended to levees have not been properly maintained, the majority (mean 4.25) strongly agreed that maintaining the existing protecting walls could decrease the aggravate of flooding in Akaki Kality Sub City. Similarly, the respondent's responses strongly agreed to the query on insufficient resources on flood risk management organizations (mean 4.03) and Akaki Kality being an origin of big rivers could aggravate flood hazard on Akaki Kality Sub-city.

Although, the majority of responses were agreed with the statements that 'too many people live in flood risk areas (mean; 'the warning systems are not good enough; 'climate change; and 'deforestation' in the mean of 3.04 with the standard deviation of .991; in the mean of 3.87 with the standard deviation of 1.233; in the mean of 3.78 with the standard deviation of .914; in the mean of 3.75 with the standard deviation of 1.130 respectively. The overall mean dimension is 3.8775.

TABLE 4-18: Serious negative consequences of floods in Addis Ababa

	N	Mean	Std. Deviation
Damage to properties and contents	122	4.29	.886
Deterioration of health conditions	122	4.34	.678
Loss of lives	122	3.98	1.008

Damage to critical infrastructure and public buildings	122	4.51	.633
Damage to livestock and crops	122	4.30	.842
Disruption of transport services	122	4.09	.996
Decrease of purchasing and production power	122	4.09	.979
Business interruption	122	3.68	1.062
Property values decrease in endangered areas	122	3.47	1.107
Pollution is spread by flood waters	122	4.22	.914
Damage to cultural or heritage sites	122	3.51	1.325
Ecological damage	122	3.76	1.206
Average		**4.005**	**0.975**

Source: SPSS output Data (2021)
***NB: 5**= Very high **4**= High **3**= Moderate **4**= Low **5**= Very low*

As described in the above table 4-18, responses to items under most serious negative consequences of floods in Addis Ababa indicates that the majority of respondents response strongly agreed to the query that, damage to properties and contents (mean 4.29); deterioration of health conditions (mean 4.34); damage to critical infrastructure and public buildings (mean 4.51); damage to livestock and crops (mean 4.30); disruption of transport services (mean 4.09) and; a decrease of purchasing and production power(mean 4.224) respectively. This implies that flood hazard has a serious negative impact on damaging the household's properties and affect livelihoods, it affects the health conditions and Couse for water bore diseases, it damages public infrastructure and disrupts transportation activities and it could cause pollution.

As portrayed in the above table, the query was forwarded to respondents concerning the flooding hazard consequences on the loss of lives. Then (mean 3.98) respondents' response agreed that flooding has caused deaths.

As portrayed in the above table, the majority of responses were agreed to the items that business interruption (mean 3.68); property values decrease in endangered areas (mean 3.47); ecological damage (mean 3.51), and; damage to cultural or heritage sites in the mean of 3.76 with the standard deviation of 1.206 respectively.

4.4.2. Descriptive analysis on the examining the practice of institutional collaboration to manage flooding in Addis Ababa

The Disaster Risk Management Commission of Addis Ababa city administration is a driving force that helps to plan, implement, monitor, and evaluate the process and product of DRM in the city and to ensure coordination among all stakeholders involved in any phase of DRM. Since floods are the most frequent type of natural hazard that occurs in Addis Ababa and it is the major reason for loss of life and damages to personal property, AADRMC takes responsibility to the flood risk management activities. Flood risk management activities in Addis Ababa focussing on reducing the likelihood and/or the impact of floods.

Even though it is not sufficient to ensure the FRM system to be functional and operational, the coordinating roles of DRM institutions are essential (DRM-SPIF, 2014). Depending on this AADRMC identified lead sector institutions that are responsible for DRM and risk prevention tasks those include:-

- The Addis Ababa City Administration office,
- National Disaster Risk Management Commission,
- Addis Ababa City Administration Road Traffic Management Agency (RTMA),
- Addis Ababa City Road Authority
- Ministry of National Defense,
- Ethiopian Red Cross Society and,
- Addis Ababa Water and Sewerage Authority (AAWSA) are amongst.

From the points, it can be understood that AADRMC has played a major role in coordinating FRM activities undertaken by line organizations and developing common baselines and methodologies for risk profiling and coordinating more unified and transparent. One interviewee response in the following way

> *In recent years, floods in Addis Ababa have increased dramatically. To solve this problem, we need to involve different stakeholders. Recognizing the seriousness of the problem, the Addis Ababa Mayor's Office has been able to solve some problems by gathering and discussing with stakeholders. Addis Ababa City Administration Road Traffic Management Agency (RTMA) plays a key role in prioritizing and paving roads, which according to the work of many worthy our city and there have a number of vehicles. The Ministry of National Defence often*

showed us their cooperation by providing helicopters whenever we need them.

From the interviewees, it can be understood that there is a multi-stakeholder committee formed by the Addis Ababa Mayor's Office, which mainly works in disaster response. A fire truck sucked one of the things that were discussed and done was that in the past, the floodwaters and now its own machine has been purchased and used. One respondent strengthen the above idea by saying

Most flood risk management activities are done only during the winter, and during the summer months, the committee does not work hard as in wintertime. This has made flood protection less sustainable. In this regard, the lack of flood-related studies has made the flood protection process unsustainable. In addition, gaps are created because the concerned institutions do not mainstream flood management in their work. Evidence of this is the fact that dust in various places has blocked drainage ditches and that the relevant authority has not acted in a timely manner, which has contributed significantly to the risk of flooding.

Different organizations' involvement has become most important in flood risk management. In addition, the implementation of increasing institutional engagement is far away from being positive, where stakeholder engagement often ends in diverse difficulties and conflicts between political leaders and stakeholder groups.

According to USAID 2012 report, development is not sustainable if it remains at high risk of disasters. However, a process of FRM is not feasible unless it is accompanied by a considerable reduction of social vulnerabilities. Mainstreaming of flood risk management is the consideration and address of risk issues in medium-term strategic development frameworks, legislation and institutional structures, sector strategies and policies, budgetary processes and, design and implementation of individual projects. When we come to Addis Ababa, Interviewees reflect their response that most sectors did not mainstream or incorporate FRM as their own work. In line with this, the responsible entity (AADRMC) did not politically empower to enforce other institutions. In terms of other institutions, the power to enforce is not given by law. As a result, gaps are being created and citizens are being affected, as the interviewee explained. One interviewee explains this:

Some institutions, even at the Woreda level, are reluctant to cooperate. The officials respond to us that they would not receive orders from such DRM institutions and unless they cooperated on the flood-related work, threatening

> *to refuse to discuss the issue again. It has been more than 10 years since the enforcement law was drafted, but it has not yet been ratified, and this has had a profound effect on our work.*

The involvement of institutions such as civil society and NGO's is at the National Disaster Risk Management Commission level, but at the Addis Ababa Disaster Risk Management Commission level, it is almost non-existent. However, discussions and training will be provided by organizing and mobilizing youth volunteers from all sub-cities to strengthen their engagement with the community on flooding management.

.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary

In summary, the findings are listed below in accordance with the study's stated objectives.

Objective One: among the total study area, flood hazard areas are calculated and 44 % of the total area were subjected to high to very high flood hazards; whereas 47% of area moderate level of flood hazards and; 9% of total area are subjected to very low to. The major factors for the study was Slope, rainfall, elevation, drainage density, LULC and soil.

Objective Two: The overall assessments of Flood Risk Management practices in Addis Ababa were slightly effective. An emergency response activity in Addis Ababa is effective. Whereas, regarding prevention and mitigation and; rehabilitation and recovery activities in Addis Ababa were slightly effective however on the perspective of preparedness and risk reduction in flood risk management activities were not effective.

There is encounter challenges on FRM practices. The community engagement level; disaster management planning between top-down and bottom-up consistency and; Lack of implementation of rules and laws are top ranked on the major areas that FRM faces. Political intension/will of leaderships; flood risk managing awareness; Lack of coordination across the disaster management cycle (mitigation, Preparedness, Response and recovery) and; insufficient support from National Government were also the major challenges subsequently.

Development of forecasting and warning services; maintain the existing drainage systems; inform the public about flood risks and their mitigation and, use of temporary flood barriers are amongst to the prevention and adaptation measures to reduce flood losses.

Exposed people do not take sufficient measures to prevent losses; Levees have not been properly maintained; Flood risk management organisations do not have sufficient resources and; An origin of big rivers are the main factors that aggravate flood losses in Akaki Kality sub city.

There are many serious negative consequences of floods like Damage to properties and contents; Pollution is spread by floodwaters; Damage to critical infrastructure and public buildings; Disruption of transport services and Deterioration of health conditions.

Objective Three: there is a multi-stakeholder committee formed by the Addis Ababa Mayor's Office however it doesn't works proactively through the year. It works only when winter comes. Institutions did not mainstream FRM as needed and there is lack of coordination among sectors. The involvement of other organizations like civil society and NGO's is at the National Disaster Risk Management Commission level, but at the Addis Ababa Disaster Risk Management Commission level, it is almost non-existent.

5.2 CONCLUSION

The purpose of this study is to assess the effectiveness of flood risk management practice in Addis Ababa, particularly in Akaki Kality sub-city. According to this objective, the following conclusion is drawn.

In conclusion, a finding confirms that most places in the sub-city were affected by flood hazards. The flood hazard map shows around 91% of the total area of Akaki Sub-city has been affected by flood hazards. This implies that all 11 Woredas of the Akaki Sub City are vulnerable to floods.

The overall FRM practice is moderately effective. There is an effective emergency response and has some improvement on an early warning. However, there is a gap on the flood hazard mitigation phase. The preparedness and risk reduction practice was not effective on flood risk management.

The data shows that in recent year's attentions are given to the FRM at the city mayor level. However, there is a lack of FRM mainstreaming in the institution's plan and day-to-day activities. The role of collaboration of institutions on FRM is very necessary, however; data shows that there was a gap. In addition, AADRMC does not have the legal power to enforce other institutions to collaboratively with them. Moreover, in the current situation, the FRM activities were seasonal and it makes flood prevention tasks difficult.

There is also no entity and a separate policy for flood risk management. Flood risk management activities are done under Addis Ababa Disaster Risk Management Commission and do not have their own policy. The involvement of civil societies and other Non-Governmental Organizations at the city level was very poor.

5.3 RECOMMENDATION

The following recommendations are given based on the study's findings to improve the current flood risk management practices:

Prevention and Mitigation:

- The AADRMC should conduct extensive risk and hazard identification vulnerability assessments.
- DRM institutions in Addis Ababa should work on strengthening the FRM mainstreaming at all level of organizational structure and should encourage multi-sectorial involvement in FRM and they should raise awareness of flood risk management among higher officials of each institution about flood risk management and unfold their role in the community.
- NDRMC, AADRMC and Akak Kality DRMC Flood control system installations in strategic areas are encouraged especially in low-lying areas

Emergency Preparedness and Risk Reduction

- The AADRMC should encourage the community to build its own capacity by establishing a community disaster risk group that will monitor flood hazards in their area and will be linked to and Sub City's DRM offices. The Sub City's DRM offices dissemination of information through fliers, television and radios and the journals is important.
- NDRMC and AADRMC should develop a coordination strategy or guidance amongst FRM departments and agencies and emphasize a bottom up decentralized approach about FRM.

Emergency Response:

- The Akaki Kality DRM bureau should maintain a comprehensive list of locations, families, and individuals who are at high risk or vulnerable to flood hazard. The hat all sub cities do annual inventory of their physical resources and capacity in order to determine their needs in flood risk response and preparedness.

- AADRMC purchase of necessary equipment's based on their respective needs in disaster phase and strengthening collaborations with other institutions like Traffic Management Authority to decrease barriers and to give quick response to the flood risks

Rehabilitation and Recovery

- AADRMC should emplace financial mechanisms that the victims can access concessional loans so as to increase their resilience.
- NDRMC and AADRMC must develop alternative development activities like as environmental protection, rehabilitation of existing resources, and adequate health care to promote sustainable development and livelihood in flood-affected and prone areas.
- AADRMC should develop a web-based Geographic Information Systems (GIS) application and the Land Management Office should manage its improper river-side settlement by drawing from the geo-spatial map flood areas, indicating flood risk levels and priority for flood zones

5.4. RECOMMENDATION FOR FURTHER STUDY

The research assesses the flood risk management practice in Addis Ababa in particular Akaki Kality sub city. Thus, based on the limitation of the study and the findings, the following areas are recommended:

- The study created flood hazard map for the Akaki Kality sub-city and discussed based on the information gathered from the community members who live solely in Woreda 03. Further research work is needed to cover other areas of the Addis Ababa City Administration by identifying flooding risk hotspot areas
- Flood risk management concept is broaden and it engages many international and local institutions, it needs strong political commitment and policies and strategies that easily applicable. Therefore further studies needed on the areas of collaboration and policy implementation with regard to flood risk management.

REFERENCE

AACFEPRA. (2018). Eighty-three perished in fire, floods year. Addis Ababa: Addis Ababa City resilience project.

Amendola, A., Linnerooth-Bayer, J., Okada, N., & Shi, P. (2008). *Towards integrated disaster risk management: case studies and trends from Asia.* Natural Hazards, *44*(2), 163-168.

Bariweni P.A., Tawari C.C. and Abowei J.F. (2012).*Some Environmental Effects of Flooding in the Niger Delta Region of Nigeria.* International Journal of Fisheries and Aquatic Sciences 1(1): 35-46. Bayelsa State, Nigeria

Bloch , R., Jha, A. K., & Lamond, J. (2011) *Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century.* Washington DC: World Bank.

Central Statistical Agency (2010) *The 2007 Population and Housing Census*. Addis Ababa: CSA.

Centre for Research on the Epidemiology of Disasters. (2011). *EM-DAT: International Disaster Database.* Unversite Catholicque de Louvain, Brussels, Belgium.

CFES (2017a). *Addis Ababa River and Riverside Developmental plan project,* Rivers pollution and Sanitation study, Centers for Environmental Science Addis Ababa University

CLUVA (2013) *Climate Change and Vulnerability of African Cities,* Research Briefs. Seventh Framework Program Deliverable. CLUVA consortium.

County, O.(2019). *Emergency Management.* Retrieved from https://www.onslowcountync.gov/581/Emergency-Management

Creswell, J. (2007). *Qualitative Inquiry and Research Design:* Choosing among Five Approach. 2nd edition. University of Nebrask, Lincoln.

Dewald, V. and Ben, W. (2014). *Integrated DRM and Development Planning:* Experience from Africa. Research gate.

DPPA, (2006). *Joint Government and Humanitarian Partners:* Flash appeal for the flood disaster in Ethiopia.

Desybel Minwuylet Desta (2020). *A Geospatial Technology Based Study on Flood Risk Assessment:* A case of Akaki Kality Sub City, Addis Ababa, Ethiopia, Addis Ababa University, Addis Ababa, Ethiopia

ECA. (2015). *Assessment Report on Mainstreaming and Implementing Disaster Risk Reduction and Management in Africa:* Addis Ababa, Ethiopia.

Elliott C. R and Leggett D. J (2002).Reducing the Impacts of Flooding: Extemporary Measures, Construction Industry Research and Information Association. London, Britain

(ERCS) (2006). *Ethiopia floods:* International Federation of Red Cross and Red Crescent Societies.

FAO**.** **(**2005). *Rapid guide for missions: Analysing local institutions and livelihoods,* by A. Carloni. Rural Institutions and Participation Service (SDAR). Rome.

FAO (2008). *Disaster risk management systems analysis.* A guide book, Rome.

Federal Government of Ethiopia, Ministry of Urban Development and Construction (2015) *Growth and Transformation Plan II*, 2015/16 – 2019/20, Addis Ababa, Ethiopia

FEMA-EMI. (n.d.). *Types of Floods and Floodplains*. Retrieved June 19, 2014, from https://www.training.fema.gov/hiedu/docs/fmc/chapter 2 - types of floods and floodplains.pdf

Feyissa, G. Zeleke, G. Gebremariam, E. and Bewket, W. (2018). *GIS based quantification and mapping of climate change vulnerability hotspots in Addis Ababa.* Geoenvironmental Disaster, 1-17.

Fritz, CE (1961). *Disaster in Merton, RK, Nisbet, RA (eds) Contemporary Social Problems.* New York: Harcourt, Brace and World, 651–694.

Gautam , K. P., & van der Hoek , E. E. (2003) *Literature Study on Environmental Impact of Floods* . Keverling Buismanweg: Delft Cluster.

Gazley, B. (2008). *Intersectoral collaboraton and the motivation to collaborate: Toward an integrated theory. In L. B. Bingham & R. O'Leary (Eds.),* Big ideas in collaborative public management (pp. 36-54). New York, NY: M.E. Sharpe.

Gerrard, S. (1995). Environmental risk management. In T. O'Riordan (Ed.), *Environmental Science for Environmental management* (1st Editio.). London: Longman Ltd.

Habtamu Alemu (2017). *Investigation of Flooding Problems in Urban Drainage System: the case at Zenebe Werk in Addis Ababa, Ethiopia,* Addis Ababa University, Addis Ababa, Ethiopia

Hermansson, H. (2016). *Disaster management collaboration in Turkey:* Assessing progress and challenges of hybrid network governance. Public Administration, 94(2), 333-349. https://doi.org/10.1111/padm.12203

Hobeika, A. G., Radwan, A. E., & Jamei, B. (1985). *Transportation actions to reduce evacuation times under hurricane flood conditions:* A case study of Virginia Beach City. Annual Meeting of Transportation Research Board.

Imperial, M. (2005). *Using collaboration as a governance strategy:* Lessons from six watershed management programs. Administration & Society, 37(3), 281-319.

Jateni Chaka (2018). *Challenges and Practices of Disaster Preparedness and Its Effect on Humanitarian Logistics Performance of the National Disaster Risk Management Commission of Ethiopia.* Addis Ababa University, Addis Ababa, Ethiopia

Journal of Earth Science & Climatic Change. (2019). *Disaster Science. Journal of Earth Science & Climatic Change.* Retrieved from https://www.omicsonline.org/scholarly/disaster-science-journals-articles-ppts-list.php

Keyton, J., Ford, D. J., & Smith, F. I. (2008). *A mesolevel communicative model of collaboration.* Communication Theory, 18, 376-406.

Kim, P. and Lee, J. (1998). Emergency Management in Korea and Its Future Directions. Journal of Contingencies and Crisis Management. 6(4).

Kusi-Appiah, Twumasiwaah, (2016). *Urban Flood Risk Management: A Case Study of Aboabo, Kumasi.* Kwame Nkrumah University, Ghana.

McEntire, David A. (2007). *Disaster Response and Recovery: Strategies and Tactics for Resilience*. Hoboken, NJ: Wiley.

Melis Nigatu (2020). *Practices and Challenges Of Disaster Risk Management In Urban Area; The Case Of Addis Ababa City, Ethiopia,* Addis Ababa University, Addis Ababa, Ethiopia

MRSC-Local Government Success. (2015). *Flood Hazard Management Planning*. Washington. Retrieved January 15, 2015, from http://mrsc.org/Home/Explore-Topics/Public-Safety/Emergency-Services/Flood-Hazard-Management-Planning-(1).aspx

Mulugeta Teferi (2016). *Causes of Flooding Hazards and Mitigation Techniques in Adama City:* A GIS-Based Risk Analysis and the Way Forward, Ethiopia

Muhammad Zein (2010). *A Community Based Approach to Flood Hazard and Vulnerability Assessment in Flood Prone Areas:* A Case Study in Kelurahan Sewu Surakarta City, Indonesia

NDRMC. (2018). *Humanitarian and Disaster Resilience Plan. Joint Government and Humanitarian Partners' Document.* A.A, Ethiopia.

OPW. (2009) *The Planning System and Flood Risk Management.* Ireland: The Office of Public Works.

Prasad, A. S., & Francescutti, L. H. (2017). *Natural Disasters. In S. R. Quah (Ed.), International Encyclopaedia of Public Health (Second Edition)* (pp. 215-222). Oxford: Academic Press.

Selamawit Birehanu (2018). *Urban Households' Vulnerability to Flooding Hazards In Addis Ababa:* A Case Study From Ginfle Stream, Addis Ababa University, Addis Ababa, Ethiopia

Shimels, H. (2013). *The Impact of DRM Intervention in Humanitarian Programs on Household Food Security:* The Case of East Africa, Ethiopia, Amhara Region, North Wollo Zone. UNOCHA Policy Development Studies Branch.

Sinafikish Gezahegn (2013). *Causes and Consequences of Flooding in Dire Dawa City, Eastern Ethiopia,* Addis Ababa Ethiopia

Sumedh, R. (2013). *DRR at National and Sub-national Levels. Applied Knowledge Services.* Helpdesk Research Report.

Tumaini A .Kimaro (2003). *Evaluating Land-Use Change Effects on Flood Peaks Using a Distributed Rainfall-Runoff Model in Yasu River, Japan.* Disaster Prevention Research Institute, Kyoto University, Japan

Twigg, John (2004). *Disaster Risk Reduction: Mitigation and Preparedness in Development and Emergency Programming*. London: Overseas Development Institute.

UNCHS. (2007). *Global report on human settlements 2007 enhancing urban saftey and security. London :* United Nation Human Settlement Program

UNDDR (UN Office for Disaster Risk Reduction). (2017). Terminology: *Disaster Management.* Retrieved from https://www.unisdr.org/we/inform/terminology

UN-HABITAT. (2017). *The State Of Addis Ababa:* 2017 The Addis Ababa We Want.

UNGA, (2016). Report of the open-ended intergovernmental expert working group on indicators and terminology related to disaster risk reduction

UNISDR. (2005). *Hyogo Framework for Action 2005-2015:* Building the Resilience of Nations and Communities to Disasters. World Conference on Disaster Reduction. Hyogo, Japan

Van Wassenhove (2006).*Humanitarian aid logistics: supply chain management in high gear.* Journal of the operation research society. 57(5), pp 475-489.

Vanessa Lucena. C, Ricardo Ruiz and Nilo de Oliveira Nascimento (2006). *Economic Consequences of the Flood:* modelling the impacts in an urban space. Belo Horizonte, Brazil.

Weber, E.P. and A.M. Khademian (2008). '*Wicked Problems, Knowledge Challenges, and Collaborative Capacity Builders in Network Settings'*, Public Administration Review, 68, 2, 334–49.

Weets, G. (2011). *Assessing vulnerability of urban systems*, In Populations and goods in relation to natural and man-made disasters in Africa. CLimate change and Urban Vulnerability in Africa.

Woodland, R. H., & Hutton, M. S. (2012). *Evaluating organizational collaborations:* Suggested entry points and strategies. American Journal of Evaluation, 33(3), 366-383.

World bank (2015). *Addis Ababa – Enhancing Urban Resilience: city strength resilient cities program*, working paper 100980, Washington D.C, 2015.

World Bank (2015) *Ethiopia Urbanization Review:* Urban Institutions for a Middle-Income Ethiopia. Washington, DC: World Bank.

World Bank. (2019). *Disaster Risk Profile Ethiopia*. Washington D.C.

World Meteorological Organizations (WMO) (2009). *Integrated Flood Management Concept.* Associated Programme on Flood Management

World Nuclear Association (2018). *Fukushima Daiichi Accident.* Retrieved from https://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-accident.aspx

Yin, R. (2003). *Case Study Research: Design and Methods.* (3rd Ed.). Thousand Oaks, Sage.

APPENDIXES

Date: _____/_____/ 2021

APPENDIX A: Experts Survey Questionnaire

Dear Respondents

As a partial fulfilment of Master's Degree in Environment and Sustainable Development, College of Development Studies, Addis Ababa University, I, Addisalem Fetene am conducting survey to study the flood risk management system effectiveness in Addis Ababa, Akaki Kality Sub- City. The study is needed only for academic purpose and your truthful answers will help the researcher to learn about the effective flood risk management practice on the ground.

I thus kindly request your assistance to response for the questionnaire and all your response will be kept confidential. I would also like to thank you in advance for taking your time to fill the questionnaires and welcomed for any questions you have.

Instruction:

1. Please answer this questionnaire with reference to your experience about flood risk management in the project you participated.

2. Please answer the questions by ticking the appropriate mark in the box, (√)

SECTION A: GENERAL INFORMATION ABOUT RESPONDENTS

Direction: Please tick (√) to the appropriate answer

1. Gender

a) Male ☐ b) Female ☐

2. Age

a) 20-30 ☐ b) 31-40 ☐ c) 41-50 ☐ d) 50 and above ☐

3. Year of work experience within your current institution

a) 0-5 years ☐ b) 6-10 years ☐ c) 11-15 years ☐ d) >15 years ☐

4. Educational Level

a) Elementary ☐ b) High school ☐ c) Preparatory ☐ d) TVET ☐

e) Diploma ☐ f) BA/ BSc ☐ g) MA/MSc ☐

h) Others; please specify_____

5. Position Held

a) Team Leader ☐ b) Senior Expert ☐ c) Expert/specialist ☐

d) Other please specify_____

6. Rate your knowledge about the following topics:

4- Very good **3-** good

2- Poor **1-** Very poor

Categories	**4**	**3**	**2**	**1**
Flood preparedness				
Early warning				
Response				
Recovery				

SECTION B: FLOOD RISK MANAGEMENT PRACTICE

Direction: Kindly indicate your answers to the space provided after each statement

7. The overall assessment of Flood Disaster Risk Management in Addis Ababa on the following Emergency Management Cycle?

5- Very effective **4-** Effective **3-** Moderately Effective
2-Slightly Effective **1-** Not Effective

Concerning Areas	**5**	**4**	**3**	**2**	**1**
Prevention and Mitigation					
Preparedness and risk reduction					
Emergency Response					
Rehabilitation and recovery					

8. Could you please rate the following as a challenge that faces on the flood Disaster Risk Management?

5- Strongly Agree **4-** Agree **3-** Moderately Agree
2- Disagree **1-** Strongly disagree

Concerning Areas	**5**	**4**	**3**	**2**	**1**
Financial/ budget scarce					
Political intension/will (Leadership)					
Awareness					
Level of Community engagement					
Lack of disaster management plan					
Inconsistency in disaster management planning between top-down and bottom-up					
Lack of coordination across the disaster management cycle (mitigation, Preparedness, Response and recovery)					
Low capacity (Manpower)					
Lack of implementation of rules and laws					
Insufficient support from National Government					
Lack of coordination between Local government units , Non-government organizations, & other agency					
Others, if any please specify:					

9. What seem the flood disaster risk management activities in terms of the following?

a. Prevention and Mitigation. Based on your work experiences on this area, what Disaster Risk Management plans are in placed your areas?

5- Strongly Agree **4-** Agree **3-** Moderately Agree
2- Disagree **1-** Strongly disagree

Concerning Areas	**5**	**4**	**3**	**2**	**1**
Hazard Mapping and urban planning in place at all level of administration					
Education, continuous trainings and awareness creation are given effectively					
Institutions, individuals and volunteers are responsible for maintaining preparedness equipment's like Antibiotics and medical kits					
Transportation which used to give service for flood affected peoples					
Proactive community participation					
Infrastructure					
in placing urban early warning systems					
Financial reserves and contingency mechanisms are in place					
Does the community have an access to get emergency contacts					
Others, if any please specify:					

b. Emergency preparedness and risk reduction. What is the level of responsiveness of Flood disaster risk factors at all level?

5- Very Responsive **4-** Responsive **3-** Moderately Responsive
2-Slightly Responsive **1-** Not Responsive

Concerning Areas	**5**	**4**	**3**	**2**	**1**
The existing institutions have efficient capacity (transportation, manpower, resource, etc.) to respond to mass loss					
The communities are aware of the official warning and respond accordingly					
Is the DRM organization adequately addressing flood risk management challenges in Addis Ababa?					
There are well-defined standards in place for the provision of relief					
Is there standardized reporting formats and analysis methods in place in the city?					
Is there an evacuation plan in place for the vulnerable community?					
The training conducted at the community level?					
The flooding awareness and public information					

programmes being undertaken to the community?					
Others, if any please specify:					

c. Emergency Response. Based on your experience, what is the extent of responsiveness for life preservation and availability of the basic needs of the flood affected community during the actual and immediately after the flooding occurrence?

5- Very Responsive **4-** Responsive **3-** Moderately Responsive
2- Slightly Responsive **1-** Not Responsive

Concerning Areas	**5**	**4**	**3**	**2**	**1**
Relief operation (Provide first aid, distribute clean up supplies like mops, gloves and tarps, Serve water and hot meals, Assess damage in impacted neighbourhoods etc)					
Rescue					
Sharing of disaster related information					
Health service					
Social support (emotionally, physically like money and housekeeping, and providing information to help others					
Early recovery mechanism					
Management of dead and missing					
Evacuation management					
Social protection intervention					
Civil & uniformed services coordination					

d. Rehabilitation and recovery. How effective was the government's response in restoring and improving the living conditions of the affected residents?

5- Very Efficient **4-** Efficient **3-** Moderately Efficient
2- Slightly Efficient **1-** Not Efficient

Concerning Areas	5	4	3	2	1
Livelihood for affected victims are in place					
There is sufficient legislation and capacity in place to minimize negative environmental consequences					
DRR incorporated into livelihood restoration/development program to build resilience to future hazards					
A sector- wise recovery framework has been developed					
Shelter/Relocation for affected victims					
Psycho Social Counselling					
Infrastructure and Relocation plan					
Post disaster need assessment					
Environmental Protection					
Socio vulnerability maps available for the sub cities					

Others, please specify

10. Rate the prevention and adaptation measures do you think that would be most effective for reducing flood losses in Addis Ababa

5- Very Effective **4-** Effective **3-** Moderately effective
2- Slight effective **1-** Not effective

Concerning Areas	**5**	**4**	**3**	**2**	**1**
Development of forecasting and warning services					
Inform the public about flood risks and their mitigation					
A water sensitive design					
Create flood risk adapted land-use plans.					
Heightening and strengthening the existing levees					
Build dams, dikes and floodwalls					
Develop disaster recovery plans					
Provide financial provisions in case of disasters					
Elaborate evacuation and rescue plans					
Maintain the existing drainage systems					
use of temporary flood barriers (e.g., sand bags)					
Others:					

11. What are the main factors that aggravate flood losses in Akaki Kality among the following?

5- Strongly Agree **4-** Agree **3-** Moderately Agree
2- Disagree **1-** Strongly disagree

Concerning Areas	**5**	**4**	**3**	**2**	**1**
Too many people live in flood risk areas					
Exposed people do not take sufficient measures to prevent losses					
Levees have not been properly maintained					
The warning systems are not good enough					
Flood risk management organisations do not have sufficient resources					
Climate change					
The building of dams has changed the water runoff pattern					
Deforestation					

12. Rate the most serious negative consequences of floods in Addis Ababa?

5. Very low **4.** Low **3.** Moderate
2. High **1.** Very high

	5	4	3	2	1
Damage to properties and contents.					

Deterioration of health conditions.					
Loss of lives.					
Damage to critical infrastructure and public buildings.					
Damage to livestock and crops.					
Disruption of transport services.					
Decrease of purchasing and production power.					
Population displacement.					
Business interruption.					
Property values decrease in endangered areas.					
Pollution is spread by flood waters.					
Damage to cultural or heritage sites.					
Ecological damage.					

SECTION C: INSTITUTIONAL COLLABORATION AND LINKAGES TO MANAGE FLOODING

13. How do you explain the collaboration of your Institution with other institutions like government, public authority, NGO, company and other societal actors?

_____

_____

How are various sectors such as (health, infrastructure, education, Water resources, Interior) participate in flood risk management issues?

_____

_____

15. Does a Research institute work together with your department to decrease flood factors?

_____

_____

16. How did you find out when the flooding is happened?

_____

_____

17. How do you inform the community about flooding?

_____

_____

18. What kind of actions is taking to decrease flooding?

_____

_____

19. Is the community involved in the implementation of Flood risk management? How do you judge their level of involvement?

_____

_____

Date: _____/_____/ 2021

APPENDIX B: Key Informant Interview

I would like to conduct an interview with you for one hour. Any information you provide will be used solely for academic purposes, and the information provided cannot be traced back to the individuals who provided it. You will do so voluntarily if you agree to participate in this research and there will be no monetary returns. You are also free to refuse to answer any questions you may have or to withdraw entirely from the research.

Thank you for your cooperation.

A. GENERAL INFORMATION

Name of the Institution: _____

Gender: [ ] Male [ ] Female

Education level: [ ] A diploma [ ] A bachelor's degree

[ ] MA/MSC [ ] Others _____

Occupations: _____

Length of residency: [ ] Less than 5 years [ ] 6–10 years

[ ] 11–20 years [ ] More than 21 years

B. GENERAL QUESTIONS

1. How do you describe the complexity of flood risks in Addis Ababa during the past years?
2. How does flooding impact the Akaki Kality compared to other places of the city?
3. What seems the flooding risk management practice on historical perspective?
4. Is there a published overview or guideline to ensure a common understanding of the detailed roles of and inter-relationships between different partners (like other government institution offices, NGO's etc.)?
5. Is there any mechanism in place to guide, monitor and integrate DRM actions within various sectors?
6. To what extent are the civil society and the private sector committed to flood risk management?
7. Are there incentive systems that encourage investment in flood risk management?
8. What are the strengths and weaknesses of these institutions who work on DRM activities?

9. Is there a policy that specifies urban flood risk management and reduction as a priority?
10. How does the highest political authority show its commitment to flood risk management?

Date: _____/_____/ 2021

APPENDIX C: Check List for Direct Observation

Date of Observation _____

Duration of Observation: [ ] 2 hour
[ ] half day
[ ] 8 hour
[ ] whole day

Residential conditions

- ✓ Housing situation:
  (Construction materials of the houses, settlement, distance from river)

Infrastructure

- ✓ Road facility:
  (Roads eroded by flood, bridges were broken and carried away)
- ✓ drainage systems
  (Availability and functionality of drainage system)
- ✓ electricity
  (Secure electricity system like concrete pole)
- ✓ health center

Measures taken by community and government to control flooding

- ✓ Blocking door and air vents
- ✓ waterproofing
- ✓ sand bagging
- ✓ building walls

Environmental

- ✓ Deforestation
- ✓ Soil erosion
- ✓ Urban green areas (urban forestry)

Capacity building

APPENDIX D: List of contacted key informant interviewees

No.	Gender	Position	Directorates	Organization	Educational level	Year of Experience
1	M	Director	Disaster Response and Rehabilitation	Akaki Kality DRM bureau	BSc	16 years
2	M	Coordinator	Early Warning and Emergency Response	Akaki Kality DRM bureau	BA Degree	9 years
3	M	Expert	Early Warning and Emergency Response	NDRMC	MA	6 years
4	F	Team Leader,	Disaster Risk Research and Implementation	AADRMC	MA	10 years
5	F	Director	Disaster Response and Rehabilitation	AADRMC	MA	12 years

APPENDIX E: Frequency Distribution of the Respondents

No	Particulars	Not Effective		Slightly Effective		Moderately Effective		Effective		Very effective	
I.	**The overall assessment of FRM Practice**										
		Fre.	**%**	**Fre.**	**%**	**Fre.**	**%**	**Fre.**	**%**	**Fre.**	**%**
1	Prevention and Mitigation	31	25.4%	46	37.7%	32	26.2%	11	9.0%	2	1.6%
2	Preparedness and risk reduction	41	33.6%	56	45.9%	12	9.8%	12	9.8%	1	0.8%
3	Emergency Response	2	1.6%	47	38.5%	26	21.3%	41	33.6%	6	4.9%
4.	Rehabilitation and recovery	54	44.3%	30	24.6%	17	13.9%	21	17.2%	0	0%
II.	**Major Challenges**										
	Particulars	**Strongly Disagree**		**Disagree**		**Moderately Agree**		**Agree**		**Strongly Agree**	
5	Financial/ budget scarce	10	8.2%	19	15.6%	35	28.7%	33	27.0%	25	20.5%
6	Political intension/will (Leadership)	9	7.4%	30	24.6%	10	8.2%	13	10.7%	60	49.2%
7	Awareness	11	9.0%	5	4.1%	21	17.2%	40	32.8%	45	36.9%
8	Level of Community engagement	4	3.3%	6	4.9%	24	19.7%	39	32.0%	49	40.2%
9	Lack of disaster management plan	0	0%	27	22.1%	24	19.7%	53	43.4%	18	14.8%
10	Inconsistency in disaster management planning between top-down and bottom-up	0	0%	14	11.5%	16	13.1%	42	34.4%	50	41.0%
11	Lack of coordination across the disaster management cycle (mitigation, Preparedness, Response and recovery)	0	0%	10	8.2%	47	38.5%	25	20.5%	40	32.8%
12	Low capacity (Manpower)	0	0%	14	11.5%	42	34.4%	29	23.8%	37	30.3%
13	Lack of implementation of rules and laws	0	0%	11	9.0%	15	12.3%	37	30.3%	59	48.4%
14	Insufficient support from National Government	0	0%	16	13.1%	33	27.0%	36	29.5%	37	30.3%

15	Lack of coordination between Local government units , Non-government organizations, & other agency	31	25.4%	17	13.9%	16	13.1%	27	22.1%	31	25.4%
III	**FRM Activities on the Prevention and Mitigation**										
16	Hazard Mapping and urban planning in place at all level of administration	39	32.0%	44	36.1%	21	17.2%	8	6.6%	10	8.2%
17	Education, continuous trainings and awareness creation are given effectively	10	8.2%	20	16.4%	50	41.0%	37	30.3%	5	4.1%
18	Institutions, individuals and volunteers are responsible for maintaining preparedness equipment's like Antibiotics and medical kits	36	29.5%	31	25.4%	34	27.9%	21	17.2%	0	0%
19	Transportation which used to give service for flood affected peoples	33	27.0%	22	18.0%	32	26.2%	19	15.6%	16	13.1%
20	Proactive community participation	28	23.0%	25	20.5%	60	49.2%	6	4.9%	3	2.5%
21	Infrastructure	14	11.5%	29	23.8%	56	45.9%	14	11.5%	9	7.4%
22	in placing urban early warning systems	29	23.8%	55	45.1%	27	22.1%	11	9.0%	0	0%
23	Financial reserves and contingency mechanisms are in place	20	16.4%	48	39.3%	19	15.6%	16	13.1%	19	15.6%
24	Does the community have an access to get emergency contacts	11	9.0%	16	13.1%	55	45.1%	13	10.7%	27	22.1%
	FRM Activities on the Emergency preparedness and risk reduction										
	Particulars	**Not Responsive**		**Slightly Responsive**		**Moderately Responsive**		**Responsive**		**Very Responsive**	
25	The existing institutions have efficient capacity (transportation, manpower, resource, etc.) to respond to mass loss	5	4.1%	16	13.1%	18	14.8%	41	33.6%	42	34.4%
26	The communities are aware of the official warning and respond accordingly	5	4.1%	31	25.4%	57	46.7%	15	12.3%	14	11.5%

27	Is the DRM organization adequately addressing flood risk management challenges in Addis Ababa?	10	8.2%	26	21.3%	28	23.0%	47	38.5%	11	9.0%
28	There are well-defined standards in place for the provision of relief	13	10.7%	33	27.0%	39	32.0%	26	21.3%	11	9.0%
29	Is there standardized reporting formats and analysis methods in place in the city?	22	18.0%	19	15.6%	45	36.9%	31	25.4%	5	4.1%
30	Is there an evacuation plan in place for the vulnerable community?	29	23.8%	28	23.0%	40	32.8%	17	13.9%	8	6.6%
31	The training conducted at the community level?	10	8.2%	18	14.8%	58	47.5%	11	9.0%	25	20.5%
32	The flooding awareness and public information programs being undertaken to the community?	22	18.0%	10	8.2%	44	36.1%	23	18.9%	23	18.9%
	FRM Activities on the Emergency Response										
33	Relief operation (Provide first aid, distribute clean up supplies like mops, gloves and tarps, Serve water and hot meals, Assess damage in impacted neighborhoods etc.)	25	20.5%	29	23.8%	32	26.2%	24	19.7%	12	9.8%
34	Rescue	0	0%	3	2.5%	19	15.6%	26	21.3%	74	60.7%
35	Sharing of disaster related information	0	0%	22	18.0%	46	37.7%	16	13.1%	38	31.1%
36	Health service	0	0%	17	13.9%	48	39.3%	22	18.0%	35	28.7%
37	Social support (emotionally, physically like money and housekeeping, and providing information to help others	3	2.5%	44	36.1%	29	23.8%	0	0%	46	37.7%
38	Early recovery mechanism	19	15.6%	20	16.4%	37	30.3%	25	20.5%	21	17.2%
39	Management of dead and missing	3	2.5%	11	9.0%	5	4.1%	63	51.6%	40	32.8%
40	Evacuation management	25	20.5%	19	15.6%	27	22.1%	48	39.3%	3	2.5%
41	Social protection intervention	11	9.0%	51	41.8%	57	46.7%	3	2.5%	0	0%
42	Civil & uniformed services coordination	22	18.0%	11	9.0%	32	26.2%	27	22.1%	30	24.6%
	FRM Activities on the Rehabilitation and recovery										

	Particulars	Not Efficient		Slightly Efficient		Moderately Efficient		Efficient		Very Efficient	
43	Livelihood for affected victims are in place	5	4.1%	19	15.6%	74	60.7%	3	2.5%	21	17.2%
44	There is sufficient legislation and capacity in place to minimize negative environmental consequences	9	7.4%	33	27.0%	75	61.5%	0	0%	5	4.1%
45	DRR incorporated into livelihood restoration/development program to build resilience to future hazards	5	4.1%	47	38.5%	45	36.9%	19	15.6%	6	4.9%
46	A sector- wise recovery framework has been developed	11	9.0%	61	50.0%	45	36.9%	5	4.1%	0	0%
47	Shelter/Relocation for affected victims	34	27.9%	38	31.1%	21	17.2%	24	19.7%	5	4.1%
48	Psycho Social Counselling	11	9.0%	23	18.9%	85	69.7%	3	2.5%	0	0%
49	Infrastructure and Relocation plan	17	13.9%	84	68.9%	13	10.7%	8	6.6%	0	0%
50	Post disaster need assessment	5	4.1%	28	23.1%	30	24.6%	26	21.3%	33	27.0%
51	Environmental Protection	14	11.5%	40	32.8%	68	55.7%	0	0%	0	0%
52	Socio vulnerability maps available for the sub cities	24	19.7%	65	53.3%	33	27.0%	0	0%	0	0%
	Prevention and Adaptation measures										
	Particulars	**Not Effective**		**Slightly Effective**		**Moderately Effective**		**Effective**		**Very Effective**	
53	Development of forecasting and warning services	1	0.8%	10	8.2%	20	16.4%	36	29.5%	55	45.1%
54	Inform the public about flood risks and their mitigation	2	1.6%	4	3.3%	27	22.1%	37	30.3%	52	42.6%
55	A water sensitive design	24	19.7%	44	36.1%	34	27.9%	5	4.1%	15	12.3%
56	Create flood risk adapted land-use plans.	29	23.8%	44	36.1%	20	16.4%	14	11.5%	15	12.3%
57	Heightening and strengthening the existing levees	17	13.9%	18	14.8%	31	25.4%	36	29.5%	20	16.4%
58	Build dams, dikes and floodwalls	19	15.6%	29	23.8%	45	36.9%	25	20.5%	4	3.3%

59	Develop disaster recovery plans	13	10.7%	47	38.5%	23	18.9%	34	27.9%	5	4.1%
60	Provide financial provisions in case of disasters	21	17.2%	27	22.1%	29	23.8%	16	13.1%	29	23.8%
61	Elaborate evacuation and rescue plans	21	17.2%	21	17.2%	16	13.1%	45	36.9%	19	15.6%
62	Maintain the existing drainage systems	11	9.0%	7	5.7%	31	25.4%	26	21.3%	47	38.5%
63	use of temporary flood barriers (e.g., sand bags)	21	17.2%	3	2.5%	33	27.0%	49	40.2%	16	13.1%
	Main Factors that Aggravate Flood Losses in Akaki Kality Sub-City										
	Particulars	**Strongly Disagree**		**Disagree**		**Moderately Agree**		**Agree**		**Strongly Agree**	
64	Too many people live in flood risk areas	5	4.1%	5	4.1%	24	19.7%	42	34.4%	46	37.7%
65	Exposed people do not take sufficient measures to prevent losses	8	6.6%	6	4.9%	17	13.9%	20	16.4%	71	58.2%
66	Levees have not been properly maintained	0	0%	19	15.6%	10	8.2%	16	15.6%	34	27.9%
67	The warning systems are not good enough	6	4.9%	13	10.7%	26	21.3%	23	18.9%	54	44.3%
68	Flood risk management organisations do not have sufficient resources	0	0%	10	8.2%	19	15.6%	50	41.0%	43	35.2%
69	Climate change	0	0%	11	9.0%	34	27.9%	48	39.3%	29	23.8%
70	The building of dams has changed the water runoff pattern	0	0%	5	4.1%	31	25.4%	44	36.1%	42	34.4%
71	Deforestation	0	0%	21	17.2%	33	27.0%	23	18.9%	45	36.9%
	Negative Consequences of Floods in Addis Ababa										
	Particulars	**Very low**		**Low**		**Moderate**		**High**		**Very High**	
72	Damage to properties and contents.	0	0%	8	6.6%	20	16.4%	40	32.8%	54	44.3%
73	Deterioration of health conditions.	0	0%	3	2.5%	5	4.1%	61	50.0%	53	43.4%
74	Loss of lives.	5	4.1%	5	4.1%	18	14.8%	54	44.3%	40	32.8%
75	Damage to critical infrastructure and public buildings.	0	0%	0	0%	16	13.1%	42	34.4%	64	52.5%

76	Damage to livestock and crops.	0	0%	5	4.1%	15	12.3%	40	32.8%	62	50.8%
77	Disruption of transport services.	0	0%	10	8.2%	23	18.9%	35	28.7%	54	44.3%
78	Decrease of purchasing and production power.	5	4.1%	5	4.1%	33	27.0%	42	34.4%	37	30.3%
79	Population displacement.	5	4.1%	10	8.2%	34	27.9%	43	35.2%	30	24.6%
80	Business interruption.	5	4.1%	20	16.4%	34	27.9%	39	32.0%	24	19.7%
81	Property values decrease in endangered areas.	5	4.1%	10	8.2%	34	27.9%	43	35.2%	30	24.6%
82	Pollution is spread by flood waters.	5	4.1%	20	16.4%	34	27.9%	39	32.0%	24	19.7%
83	Damage to cultural or heritage sites.	10	8.2%	21	17.2%	28	23.0%	23	18.9%	40	32.8%
84	Ecological damage.	8	6.6%	10	8.2%	28	23.0%	33	27.0%	43	35.2%