COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

ASSESSMENT OF HOUSEHOLDS' VULNERABILITY TO FLOOD ALONG GINFLE WATERSHED AND THEIR RISK MANAGEMENT STRATEGIES, ADDIS ABABA, ETHIOPIA

BY

ELSABET GORFU

MAY, 2022

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ADISS ABABA, ETHIOPIA

Declaration

I am Elsabet Gorfu declare that the thesis proposal have CFSS handed by me for the qualification of Msc degree at Addis Ababa university, independent work and that I have not previously submitted the same work for qualification in another university or faculty.

Elsabet Gorfu _____ _____

Signature Date

Supervisor's approval

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge as an advisor.

Major Advisor: TemesgenTilahun Signature: _____Date:

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Examiner	Signature	Date
_____	_____	_____
Examiner	Signature	Date
_____	_____	_____
CFSS Head	Signature	Date

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AAFEPRA	Addis Ababa Fire and Emergency Prevention and Rescuer Agency
CSA	Central Statics Authority
CFES	Centers for Environmental Service
CFSS	Collage of Food Security Studies
CVI	Composite Vulnerability Index
EVI	Exposure Vulnerability Index
FGD	Focus Group Desiccation
GPS	Global Position System
GIS	Geographic Information System
KII	Key Informant Interview
IPCC	Inter governmental Panel on Climate Change
NMA	National Metrology Agency
MM	Millie Meter
UN	United Nation
NGO	Non-Governmental Organization
SVL	Sensitivity Variability Index
VVI	Vulnerability Variable Index
FVI	Flood Vulnerability Index

ABSTRACT

The assessment of households' vulnerability to flood alongside Ginfle watershed and their threat control strategies Arada Sub-city, Addis Ababa, Ethiopia. The study adopted cross sectional survey research design types, explanatory and descriptive research design was applied and both quantitative and qualitative research types of data were collected from primary and secondary sources. The quantitative data were collected from household through interview schedule while qualitative data were gathered using key informants interview, focus group discussions and observation. To select the study area purposive samplings and 215 participants were selected by applying random sampling technique. In order to attain the proposed objectives the study employed instrument like questionnaire, KII, FGDs, and Personal Observation. The data were analyzed by using descriptive statistical analysis (such as frequency, percentage, mean and Standard Deviation and vulnerable index. The exposure indices for past flood experience is 0.97 and household location from the river 0.99. The calculated exposure indices were high because more than 0.98 % of the people in this area had previously experienced flooding. Among the 215 respondents 156(72.6%) said that their household are vulnerable to flood the rest 59 (27.4%) did not vulnerable to flood this indicates that serious concern are need for improvement of flood vulnerable area. Based on the finding concluded that flood vulnerability along Ginfle river higher when calculate vulnerability, exposure, sensitivity of the study area need serious concern because vulnerability level in this are 0.98 showed . It is recommended that the Addis Ababa city administration with concerned stakeholder implement better land use planning, adapt early warning, awareness creation, providing weather forecast, public participation and designing sustainable flood manage strategies should be implemented. Lastly, future researches should adopt an inductive and participatory approach to assess vulnerability.

Keywords: *Flood vulnerability, vulnerability index, Ginfle watershed, Addis Ababa,*

CHAPTER ONE- INTRODUCTION

1.1. Background of the Study

Floods are the most common occurring natural disasters that affect human and its surrounding environment. It is more vulnerable to Africa and other developing country regions. It affects social and economic stability of a country. Floods are now regarded as the most frequent and devastating natural hazards, causing fatalities, displacement, and severe economic damage worldwide, affecting both developing and developed countries (Vojinović, 2015). According to the result of Balica, Douben, and Wright (2009), flood disasters occur because of either natural factors, such as climate change and climate variability or anthropogenic factors (socio- economic and land-use development). A flood or a combination of several types of floods in cities include those of rivers, coastal floods, pluvial, ground water and floods caused by human errors (Jha, Bloch, Lamond, 2012; Vojinović, 2015).

Urban floods are one of the maximum not unusual places and extensively dispensed herbal dangers for lifestyles and assets worldwide. It has been suggested that with inside the remaining decade, city floods have impacted maximum elements of the sector along with the USA, Europe, Asia, and Africa inrush happens with inside the growing countries in addition to with inside the maximum evolved international direction. In the evolved world, city inflow is regularly associated with hazards, together with weather alternate, hurricane surge, flash floods, and consecutive heavy frozen rain. However, the reasons that be successful with inside the evolved world, flooding in growing international locations is wise because of the precariousness of the drainage system, the shortage of upkeep of the infrastructures and managed family wastes effects of flooding are anticipated to upward push because of populace increases, monetary increase and weather alternate.

Hence, information the bodily and temporal traits of hazard drivers (hazard, publicity and vulnerability) is needed to broaden powerful flood mitigation measures. Here, the long-time period fashion in flood vulnerability became analyzed globally, calculated from the ratio of the suggested glide river floods are one of the maximum not unusual place herbal hazards, inflicting excessive affects worldwide (Masahiro et al., 2016).

Vulnerability to flood has many dimensions along with social, geographical, economic and political. The cliental extrude of flood vulnerability is complicated and dynamic relying on economic, social, demographic, cultural, institutional, and governance factors. Vulnerability to flooding therefore, has many dimensions along with social, geographical, economic and political that impact how inundation have an motive on population in various approaches and with one among a kind intensities and concrete facilities in Africa are seemed as flood catastrophe danger due to fast urbanization, human sports activities and their vulnerability to the impacts of a couple of hazards. These towns are increasingly more over stretched to excessive-density populations with insufficient infrastructure and primary services. Given the excessive percent of casual settlements with corresponding substandard homes now no longer safety of belongings and improvement of lousy town increase in African towns flood mortality can also preserve to increase. Urban citizens have lots a great deal much less capability and few assets to mitigate or get over shocks. In order to lessen the flood danger and growth resilience, there may be a want to amplify the effect of influx exposure locating framework for element know-how dominant root reasons of influx hazards (Malan and Amand, 2017).

In Ethiopia context the wet season is focused with inside the 3 months among June and September to approximately 80% are rained. Down go with the drift are not unusual place in maximum elements of the United States. However extreme rainfall with inside the highlands may want to purpose flooding of settlements near any stretch of river course. A basic river basin that has high flood cause is the Awash river basin placed with inside the Rift valley**.** Soaking improvement with inside the river flow is pretty higher and is placed with inside the flood plains on both face of the Awash river. High monetary harm takes place for the duration of flooding alongside of this river basin. Vicinity with inside the order of 200,000-250,000 haketar is challenge to be flooded for the duration of excessive flows of the Awash (Daniel, 2007).

Addis Ababa is susceptible to riverine in addition to flash floods because of excessive climatic activities and top catchment sports and the vulnerability to flooding is greater irritated because of a negative drainage system, speedy housing improvement alongside river banks and the usage of beside the point production substances(Dereje et al., 2016).

In deed strongly correlated with the vulnerability of flooding and medical evaluation of chance control techniques of flood on the unique region with all its traits and styles of flow. That is why this look at is focusing at the reasons of flooding risk and mitigation techniques in Addis Ababa metropolis with the unique interest to flooding alongside Gnifle watershed.

1.2. Statement of the problem

The discount of inexperienced structures, incorrect plan of street and the boom with inside the impervious place in city regions generates extra floor runoff even from everyday storms and the conditions might be extra worst while bad humans settlement in regions that are danger thinking about the flood danger of Addis Ababa city (Dereje, 2016).

Addis Ababa city is a metropolis stricken by wet season flooding flowing to numerous elements inclusive of bad city making plans and stable waste control, growing popularities size, deforestation, misuse of sewerage tubes, and growing paved floor regions. On the other hand one of the first rate troubles that age rebates.

Flooding with inside the metropolis are use extrude at the upland catchments and the absent of right and coordinated watershed control practices on those coherent regions specially in reveres sides, greater over the metropolis has no drainage grasp plan and the prevailing flood control shape is inadequate because of those most and focused rainfall occurs with inside the up land catchments, very excessive speed and excessive water go with the drift from the one up land catchment right all the way down to the metropolis a certain flooded .

This study therefore, tries to synthesize applicable data approximately the reasons and standing at Ginfle catchment flooding in Addis Ababa with unique river to the families residing alongside protracted Ginfle catchment the risk turned into stick socio and environmental records to appearance in to the difficulty below investigation.

This have a look at turned into now no longer best cope with the vulnerability of flooding however additionally cope with control techniques of flood risk. Flood vulnerability statues of the families and the degree taken with the aid of using network the authorities reception of the families on flooding dangers and the best ahead with the aid of using bringing the hassle to the tangible data.

1. 3 Objectives of the study

1.3.1 General objective

- The goal of this study is to evaluate the households' vulnerability to flood alongside Ginfle watershed and their threat control strategies.

1.3.2. Specific objectives

- To determine the vulnerability degree of flood alongside Ginfle watershed.
- To perceive the reason of family vulnerability to flood alongside Ginfle watershed.
- To encouraged destiny intervention and threat control techniques in assuaging flood hazard.

1.3.3. Research questions

These studies changed into supposed to reply the subsequent primary questions which might be derivatives of above monition studies objectives.

- What is the vulnerability degree of flood alongside Ginfle watershed?
- What is the perceive reason of family vulnerability to flood alongside of Ginfle?
- What is the intervention and threat control techniques in assuaging flood hazard reasons of flood vulnerability alongside Ginfle watershed area?

1.3.4. Scope

The scope of this look at involved on vulnerability of flood and hazard control techniques awareness mainly vulnerability regions in Addis Ababa humans residing alongside of Ginfle watershed area.

1.3.5 .Limitation of the study

The limitation of this study could restrain to the troubles of motive and outcome of flooding in Addis Ababa town. Addis Ababa town really well worth unique side laying keep round streamed the opposite vision could on counting with inside the route have a look at steeply-priced much less of satellite television for areal grid, monthly temperature a rain fall metrology records and statistics gaps. The different challenge is unwillingness of respondents to a few a part of this question. In addition to this system coordinator could now no longer deliver actual statistics for

questions. When collected the data difficult to get full information from respondents in selected household this happened due to the problem of occurring Covide -19 during collecting the data.

1.3.6. Significance of the study

According to Selgen (2019) finding for improving the necessity of examine. This examine is number one geared toward flood catastrophe specialists its motive is to allow them to apprehend the whole variety of flood troubles associated with its reasons and result. At the identical time it affords beneficial facts for policymakers, researchers, civil society, and national kingdom and neighborhood authority's officers chargeable for catastrophe control to assist them and socio-monetary interrelationships at the same time as handling flood nature and traits so one can lessen the outcome.

They looked at changed into vital as it assesses and estimates the consequences of the floods at the community's vulnerability to flood additionally ,endeavors to set up the underlying reasons of vulnerability of human beings dwelling alongside the water shade location community. More importantly it changed into inspect that the outputs look at key inputs with inside the designing of sustainable danger control techniques measures to decrease the effect of floods and the related risks additionally enables to pick out flood vulnerability stage to increase danger control techniques in and round Addis Ababa. Moreover this take changed into wipers and effect for the long time watershed control making plans and flood important practices with inside the metropolis management of Addis Ababa. Finally changed into hired exclusive methodologies' specifically provide far off sensing strategies that have a vital contribution for the educational societies in making similarly research and different associated investigation.

CHAPTER TWO- LITERATURE REVIEW

This chapter tries to present an over view of the theoretical literature related empirical studies, the literature gap and the conceptual frame make of the study. It focuses on the cause and impact of flooding and land use dynamic flooding. The chapter then concluded by providing the analytical from work depicting the conceptual road map of the study in the context of Addis Ababa.

2.1. Concept of flood

Flood is parts of earth natural hydrological cycle. The cycle flow water throughout the environmental sometimes the hydrological cycle gets outs of balance sending more water to an area than it can normal handle. Urban flooding is an increasingly important issue which flooding is one of the major natural disasters which affect the prosperity, safety and sustainable of the resident of human settlements. The term flood occur a flow of water over areas which habitually dries. It covers range of events many of which can also the form of storm surge or costal degradation from glacial melt, snow melt or rainfall water course and from ground infiltration. Cause of flooding is occurring by a combination of natural and human made factors (Abbas *et al*., 2011).

Rising rivers are the greatest world impact and this is a phenomenon that seen a process. A rising river is a natural and unpredictable process, with major environmental consequences, consisting of a large and sudden increase in flow. It should be noted that a rising river is not the same as a flood, as the latter refers to the in foundation of territory adjacent to the low-flow channel underwater submersion of a terrestrial area that is normally not covered. Rising rivers do not always produce floods, and floods do not always come from rising rivers. Rising rivers can be regular and exceptional less frequent but a greater magnitude. Although the term "flood" is used for both rises and flood we should differentiate clearly between them. Resistance threshold increasingly major environmental changes accelerated processed and increased interactions erosion and transport (Horacio and Alfredo, 2016).

Flood risk management need serious activities of several professionals such as hydrologists, hydraulic engineers, economists, social scientists, ecologists and planners for reducing flood hazard impacts. In each of these areas there are different methods for assessing flood risk and its vulnerability. The repetition of risk assessments after flood mitigation measures both structural and nonstructural measures lets effective judgment of the efficiency of each measure and also leads to identification the components of risk which need additional mitigation (Hajar *et al*., 2016)

2.1.1 Theories related to flood

2.1.1.1 Flood vulnerability in the World

Vulnerability differs from place to place. There is a relation between vulnerability and flood induced hazard. The negative impact of flood hazards depends on people's vulnerability patterns. Vulnerability to floods is expressed by several factors such as the levels of economic status, control over assets and controlling power of hazard or disaster and livelihood opportunities. The total number of world deaths was about 170,010 due to floods between 1990 and 2000. On an average about 196 million people in more than 90 countries are suitability to catastrophic flood every year. Asian countries like India, China, Bangladesh, Indonesia, Pakistan, Myanmar, Iran and Afghanistan with 40 million people are high vulnerable to flood disaster. In the decade of 1971-1980 Bangladesh was in the third position as disaster risk country but in 1981-1990 the position has changed. So, the term "vulnerability" has come to first in the academic area and policy agenda vulnerability differs from time to time and context to context. High number of populations around the world is vulnerable to natural disasters (Enamul and Mallikakram, 2015).

River floods are one of the most common natural hazards, causing serious impacts worldwide. Previous studies have indicated that increased cause of people and assets as a result of population increase and economic growth has caused more damage due to weather-related natural disasters including flooding. In addition climate change may increase the frequency or magnitude of flooding. The impact of flooding is especially harmful in developing countries due to low levels of flood protection. For example 6,648 flood fatalities were recorded in 2013 in India and Nepal, while the Philippines has protect from recurring flooding that caused more than 100deaths every year between 2011 and 2013 and happening of flooding in Thailand in 2011 caused serious economic losses . Developed countries have also protected from flooding in Europe the Danube

flooded in 2013 in the Kinu River in Japan in these controlling risk factors change geographically and temporally, an understanding of their physical characteristics is necessary for the protection of future flood risks and the development of scientific flood mitigation measure (Masahiro, 2016).

The most common type of flooding in the United States is caused over bank flooding. over bank flooding happen when downstream channels receive more rain or snow melt from their water shed than normal or a channel is blocked by an ice jam or debts over bank flooding varies with the water shed size and terrain one measure of a flood is the speed of its moving water, which is called velocity. Floods disrupt normal drainage system in cities, and sewage spills are common, which represent a serious health hazard along water and wet materials in the home (www.enviroment.agency.gov.uk/fun). River channels change as water moves downstream acting on the channel bottom .This force is made more happen during a flood when the river's velocity increases. Development along the coasts of the oceans, the Guitar Mexico and large lakes can be exposure to two types of flood problem not found in riverine areas coastal stamps and costal erosion www.preucntion web.net fires.

2.1.1.2 Flood vulnerability in Africa

Although Africa is the least urbanized location with inside the international its city habitat are predicted to double via way of means of 2030. As end of the finding there's a predicament among network making plans and methods of acquiring sustainable city improvement. Thus city flooding is in all livelihood to worse and the continent is understood to be excessive susceptible to weather extrude because of intense poverty and wars etc. In sub-Saharan Africa in which approximately 72% of city population stays in slums the results of city flooding will be worsened via way of means of the death of good enough safety infrastructures. Studies said that West Africa is specially challenged to city floods. The location became struck in 2007 via way of means of heavy precipitation inflicting enormous local flooding that affected a complete of 792,676 human beings and precipitated 210 deaths (Malan, 2017).

There were varying underlying causes of vulnerability to floods for most people in Proximity to the flood prone area (57%), residing in flood prone area and poverty (18%) were select as being the main underlying causes of vulnerability by the Sikaunzwe community. The research revealed

that the main underlying causes of vulnerability for the sampled households were residing in flood prone areas and poverty (Yande, 2009).

Most highly affect the East African coast and Tanzania in particular. Many urban and rural communities are varying degrees of flood risk which overlooked may bring losses. It has been expressed that floods are the main cause of climate-related hazards in the Greater Horn of Africa (GHA) region. Flood risk is exacerbated by the increasing population and ever-increasing encroachment of urban development into traditional flood-plain areas. This together with the prevalent climate change phenomena means that it can be highly expected the future will hold more flood disasters than the past. Some notable examples of the loss caused by floods in the region are damage both to life and property experienced throughout the region during the 1997/1998 associated floods and the 2011 floods that occurred the coastal city of Dares Salaam and claimed lives (Shingirirai, 2013).

Flood and consequence all over the world are becoming too frequent and threat to sustainable development in human settlements. Nigeria's one of the largest countries on earth respect to water resources. Flooding is one of the major environmental losses with in the century. Flooding that happen in same part of Nigeria in 2012 is the counties worst in living memory. Floods are among the most serious natural disasters in the world claiming more lives and causing more property damage than any other natural phenomena Nigeria through not leading in terms of claiming lives flood affected and displace more people than any other disaster it also cause more damage to properties (Ibrahim , 2014).

2.1.1.3 Vulnerability of flood in Ethiopia

Floods and droughts have been a devastating hazard over Africa in general and Ethiopia in particular. For instance in sub-Saharan Africa the general effect of floods and droughts together were responsible for around 80% of deaths related disasters and 70% of economic losses compared to drought hazards that have got detailed and best coverage information regarding the intensity and scale of urban settlements exposure to flood risks in African cities are still limited. Flooding and flood-induced vulnerabilities have been undermined and neglected and only very little attention was given to Ethiopia. Natural hazards currently the impacts of floods have given importance because of the increasing amount of people economic activities and ecosystems that are impacted by its adverse effects. Historical information and recently written documents show

that Dire Dawa city is highly affected by flood risk than other disasters. As a result urban flooding risk remained to be the most devastating natural disaster affecting more people and causing property damage than any other kind of disasters. Developing specific local urban flooding vulnerability's is the happen of developing sustainable flood risk management as the development of such indicators contributes for better understanding of food hazards, flood vulnerability assessment and flood risk perceptions in a given locality (Sitotaw and Hailu, 2019).

Ethiopia has a high of hugged mountainous to graph with altitude that range 4650 meter above sea level to 420 meters below sea level wide differed in elevation means that various climatically condition occur in Ethiopia. The rain fall also various from place to place in rivers average 2400mm/year in the northern part. Flooding is a common in Ethiopia during rainy season between June and September and the major type of flooding which Ethiopia is experiencing are flash flood and hivers floods river flood the over flow of rivers from their banks and extent to low-lying areas as a result of intense rain fall or reduction (Sameson, 2008).

Climate changes and increasing need for dwelling and industrial properties have a tendency to increase the risk of flooding and many development activities which are situated in flood plain seen increase the risk and cause of flooding (Selamawit, 2018).

Flood is one of the major natural hazard in Ethiopia which causes serious damage to lives and livelihoods in different area of the country. Flooding in Ethiopia as mainly connected with to rainfalls and the topography of the highland mountains and lowland plans with natural drainage system formed by the principal livers basins. Flashfloods occur in lowlands areas when excessive rain fall in adjustment highland areas. Flash flood mostly affect areas include central, southern and western Tigrai, etc. In Ethiopia flood usually takes place at the peak of Kirmet rainy seasons (FDRENDRMC, 2018).

2.1.1.4 Vulnerability of flood in Addis Ababa

Addis Ababa is vulnerable to riverine as well as flash floods due to extreme climatic events and upper catchment activities and the vulnerability to flooding is serious due to a poor drainage system rapid housing development along river banks and using inappropriate construction materials. Over one century of rainfall analysis particularly considering the rainy season (June to September) showed an increasing trend of rainfall approximately by 18 mm per decade from

1951 to 2002. According to the Intergovernmental Panel on Climate Change (IPCC) report eastern Africa annual rainfall is expected to increase. Recent study in Ethiopian summer

(Kiremt) season using high-resolution models participating in coupled model inters comparison. Due to rapid urbanization and population increase low-income communities are forced to settle in flood-prone areas additionally the poor drainage systems of the city also intensify the risk of flooding as well. The reduction of green structures and the increase in the impervious area in urban areas generates more surface runoff even from regular storms and the situations will be more worst when poor people settle in areas which are vulnerable to flooding such as riverine and low-lying floodplains(Derji, 2016).

In Addis Ababa lack proper record on flood incidence the available records are UN available, although to retinal flooding in frequently occurs within various part of the city. In Addis Ababa include river flooding and storm water runoff from steep slopes. In 2005 seven major incidences were occurred affecting 362 household and 1302 family members. In 2008 nine incidences occur that affect 131 household along 352 family members. In 2009 317 household 647 family members were affected registered among six incidences. In 2010 the city respond about 147 persons were affected and 39 residential household were damaged. The flood incidence in Addis Ababa have been exacerbated informal housing occupation and agricultural practice particularly in high sloping areas like the Jemo mountains chain, Repi hill, little Akiki River banks and Ginefle watershed (Wilbard.*et al.*2015).

2.2. Flood risk management strategies

Strategies to limit flood hazard to highways in Egypt. Increasing the flood safety of roads on Egypt's red sea coast is especially crucial given the speedy growth with inside the significance of tourism with inside the region over the last 30 years. The paper identifies flood model measures for roads which encompass the development of a chain of contour stone bunds with inside the upstream catchments with attenuation dams in addition downstream. The engagement with hazard groups on the graduation all through flood modeling and mapping sports has brought about extra correct depiction of the city flood hazard to lessen rural groups' vulnerability to floods in Mozambique via way of means of growing their attention of floods and enhancing preparedness (Darren, 2020).

According to, Paul et al. (2013).Flood hazard control strategic technique has more than one desire referring to more than one time and area scales. Achieving those is predicated at the improvement and implementation of suitable portfolios of measure (in which the benefits of one compensates for the negative aspects of another) a technique this is complex via way of means of the converting nature of the flooding device via climate, geomorphologic and socio-financial influences.

Accepting that the destiny is unknown influences at the manner wherein plans are made and selections implemented. Flood hazard control consequently embeds a non-stop technique of model wonderful from the effect and maintain' philosophy of a conventional flood protection technique. Taking along run whole-device view locations far better call for upon the ones terminated by flooding and people chargeable for its mitigation. It entails collaborative motion throughout governments, the general public sector, businesses, voluntary businesses and individuals.

Infrastructure control making sure the perfect overall performance of man or woman flood guard's assets and the asset structures they make up are a substantial challenge. The standards of hazard assist combine quickly to longer-time period moves to maintain, repair, enhance or update property as it should be along nonstructural measures. The Hyogo framework for Action 2005–2015 (ISDR, 2005) explained that emergency planning and management loss of life and injury can be significant in major flood events highlights the central role for emergency planning in ensuring that a flood event does not become a flood disaster.

Flood hazard and risk mapping in recent years flood maps have increasingly used to communicate risks to a wide range of stakeholders. As the supporting technologies continue to improve, understanding the advantages and limitations of each is vital if communication is to be meaningful and useful. Early warning systems flash floods bring fast-moving and rapidly rising waters with a force to destroy property and take lives. Hurricane/cyclone intensity can quickly change and evacuation suddenly becomes necessary.

Early warning of these hazards can dramatically reduce human losses and damage to high-value property contents. Effective land controls and building codes. Avoiding development in high-risk areas limits the areal consequences of flooding and sound building codes can enable many structures to survive flood events with minimal damages. Insurance for those insured flood insurance provides a mechanism for them.

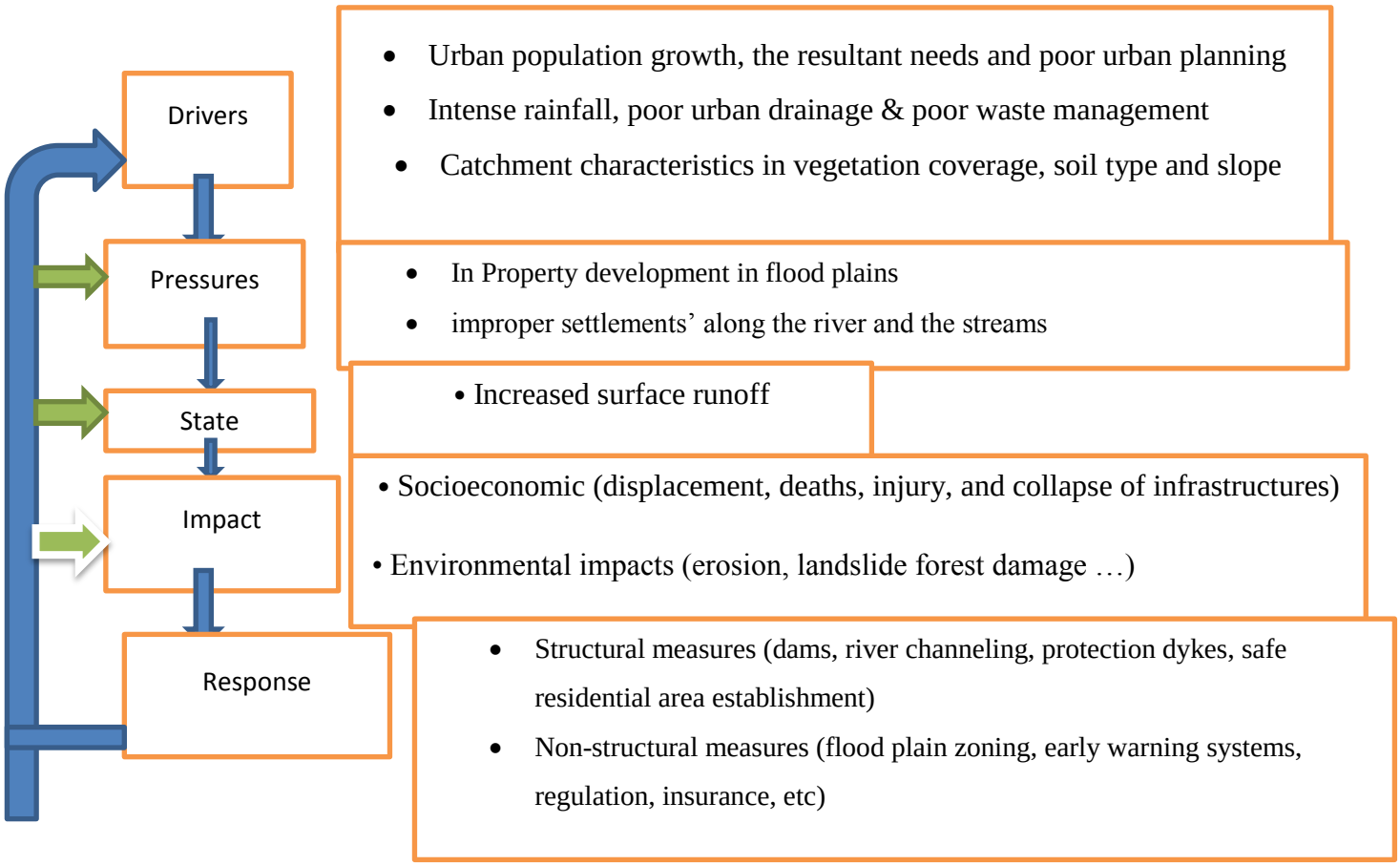


Figure 1: Hyogo Framework for Action 2005–2015 (ISDR, 2005)

2.3 Conceptual framework

Vulnerability may be described because the aggregate of danger, families' situations and their moves to the danger. The assumption of Alwang et al. (2001), a few trendy precept associated with vulnerability consist of: (a) it is miles forward-searching approach, (b) it is miles described because the possibility of experiencing a destiny loss because of drawback danger, (c) the quantity of vulnerability relies upon at the traits of the danger and the family's performance to reply to the danger, (d) a family can be susceptible to danger over the very subsequent period, for example subsequent month, year, etc., and (e) the persistent and brief negative are susceptible due to their publicity to dangers and restricted abilities to manipulate the danger. The vulnerability framework for this research, drawn in figure, starts off evolved with a belief of danger.

Risk is expressed by way of acknowledged or unknown possibility distribution of floods. All individuals, families, groups or countries face a couple of dangers from floods in Bangladesh. Flood dangers are characterized via way of means of the magnitude (along with length and spread), their frequency and duration and their history all of which have an effect on family's vulnerability from the risk. Households, groups or even countries which are uncovered to danger can reply to or manipulate flood dangers in numerous ways.

Households may also use formal and casual danger control devices relying on their get right of entry to those devices. Thus serious discount and reducing danger publicity techniques may be generated from vulnerability estimates. For example, while high susceptible regions to floods are detected, then danger discount approach may also take region via constructing dams or canals or moves for reducing publicity to flood damage may also consist of migration to upland regions.

Vulnerability measures also can assist human beings to take damage mitigation techniques that consist of formal and casual responses to predicted losses inclusive of self-insurance (example. life insurance savings) and constructing social networks. Way of submit coping rule are responses of individuals, families or groups that take region after floods outcomes are realized. such coping mechanism after floods may also contain promoting assets, borrowing cash for meals, getting rid of kids from school, converting agriculture and farm animals practices, converting employment or operating patterns, converting intake habits or migration of decided on own circle of relatives members, or maybe begging. Some governments, NGOs and overseas

resource organizations offer formal protection nets inclusive of public paintings applications, micro credit score applications or meals resource that assist families to deal with flood dangers in Bangladesh.

The following box explains the working concept of vulnerability used in this study.

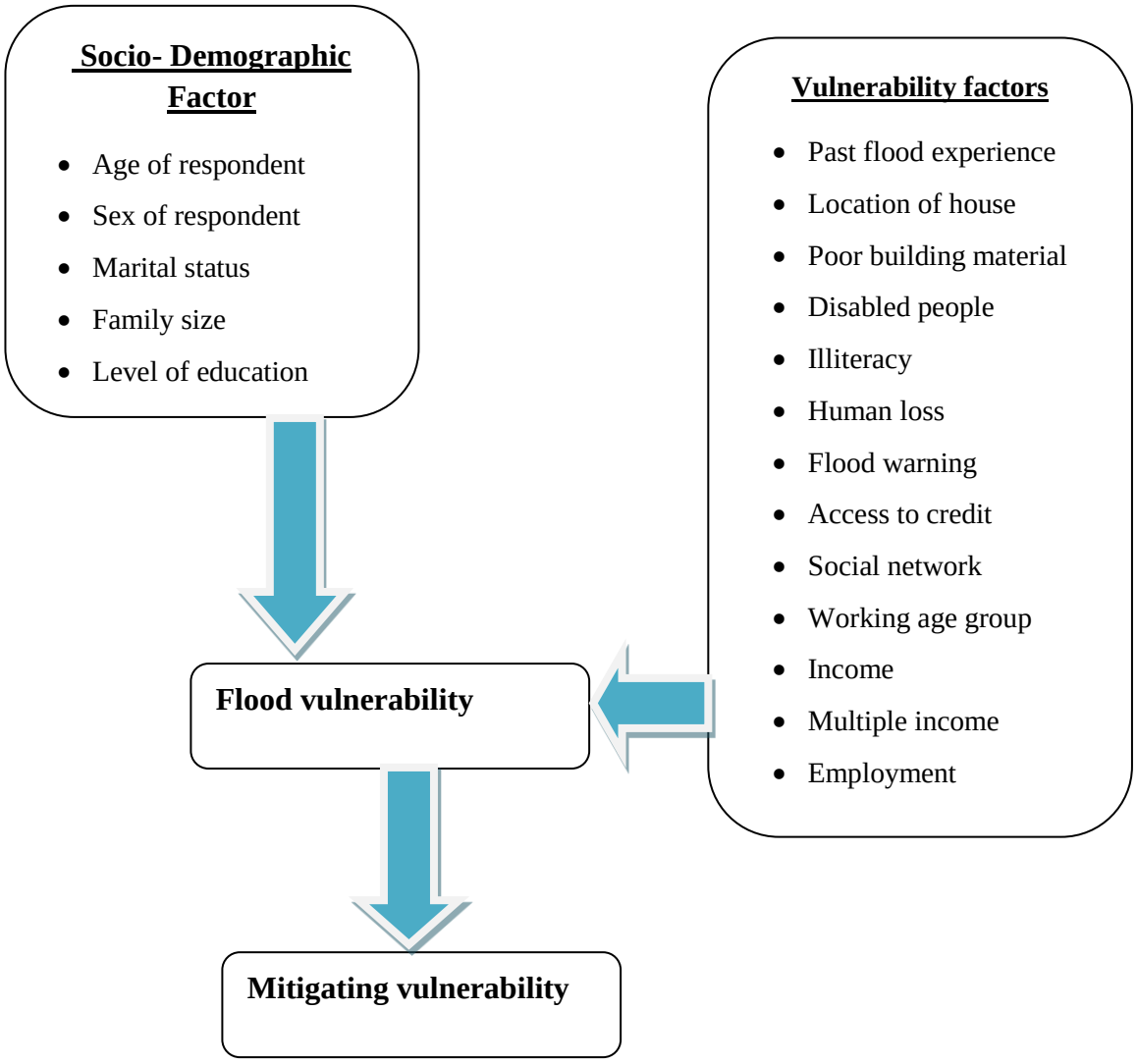


Figure 2: Conceptual Framework

Sources: Literatures different books researches publications and researcher own

CHAPTER THREE-RESEARCH METHODOLOGY

3.1. Description of the study Area

3.1.1. Location

Ginfile Stream is a stream in Addis Ababa Administration and Ethiopia (Africa) with the place font code of Africa/Middle East. It is placed at an elevation of 2,353 meters above sea level. Current nearby time is 15:49; the solar rises at 07: forty two and units at 19:50 nearby time http://www.getamap.net/maps/ethiopia/.

Founded in 1886 Addis Ababa is the capital city of Ethiopia and it is located at 9°2'N latitude and 38°42'East longitude with altitude ranging from 2,100 meters at Akaki in the south to 3,000 meters at Entoto hill in the North (CFES, 2017). Its geographic area has grown quickly over the last decade expanding from 11,000 hectares in 1995 to the current built up area of the City lying within the big and little Akaki river basins which has a catchment area of about 540 square kilometers (CFES, 2017).

At the end of the middle catchment zone and beginning of the lower catchment zone, big-Kabana joins big-Akaki at a junction called Worku sefer, forming a fifth order stream named Akaki before entering the Aba-Samuel reservoir(CFES, 2017).

In Addis Ababa the growing fashion in populace growth, urbanization and industrialization places an excessive stress on city environmental control Liquid waste discharge in to the river consisting of sewer line, municipal strong waste damping at the river banks. Almost all of the drainage device opens their out allow to the river device in Addis Ababa. Hospital wastes discharge in to the river open defecation at the banks of the rivers floor runoff from municipal. The beside the point practices of dumping home and business wastes into the river catchments have led to turning the rivers in to sewer line services.

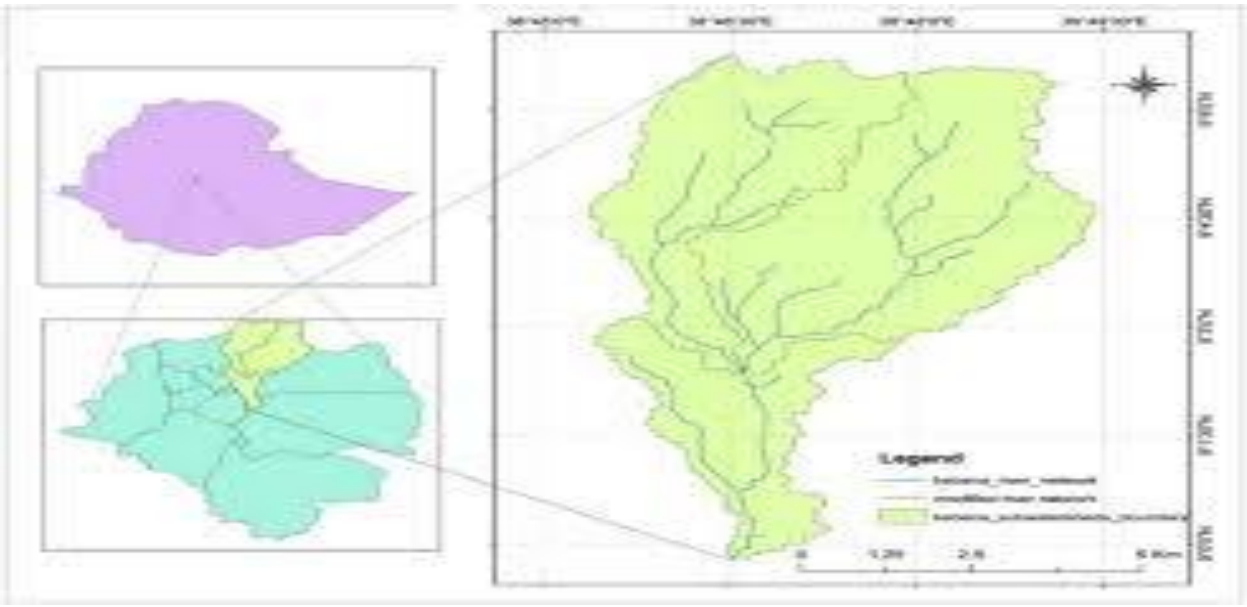


Figure 3: Addis Ababa: Major, sub-cities and its national settings

(Source: competed by the Researcher2021)

The findings according to (CFES, 2017) Due to current bad waste control technology, home, industrial and commercial waste disposal structures alongside the riverbanks, city rivers are severely laid low with pollutants and categorized as badly polluted rivers. The maximum impacted rivers with inside the metropolis consist of Banteyiketu, Kechene, Kebena and little Akaki river.

3.1.2. Climatic conditions of Addis Ababa

The warmest month, on common, is May with a mean temperature of 65.0°F (18.3°C). The coolest month on common is July with a mean temperature of 60.0°F (15.6°C). The maximum recorded temperature in Addis Ababa is 97.0°F (36.1°C), which changed into recorded in May. The lowest recorded temperature in Addis Ababa is 28.0°F (-2.2°C) which changed into recorded in February. The common quantity of precipitation for the year in Addis Ababa is 47.7" (1211.6 mm). The maximum precipitation on common is August with 281.7 mm of precipitation.

3.1.3. Land use, vegetation and ecosystem service in/around Addis Ababa

The sub-watershed extends from the Entoto mountain ridges in the north and descends down to the Aba-Samuel reservoir after joining the big-Akakiriver. Big-Kebena sub-watershed is strategically important because of its important position in the city and it is the seat of the major political, historical, administrative, commercial and diplomatic establishments in the country in general and the city in particular. Historical museums and Addis Ababa university are found in the urban segment of the big-Kebena sub-watershed (CFES, 2017). This capital city holds 527 square kilometers of area in Ethiopia. The population density is estimated to be near 5,165 individuals per square kilometer available.

3.1.3.1The history of Addis Ababa city

The land is the modern day web page of Addis Ababa turned into first occupied and made agreement with inside the early to mid-fifteenth century, even though the town as its miles recognized nowadays turned into now no longer based until 1886. It's exciting to observe that proof of people dwelling with inside the region as much as 100,000 years in the past has been discovered.

Emperor Menelik II based the town. When Menelik II turned into named because the emperor of Ethiopia the primary capital region of Entoto turned into wrought with excessive bloodless and an absence of firewood the empress driven to have the town moved to a hotter region nearby and the town that evolved turned into distinct because the capital town.

3.2. Research design

This examine assessed the families' vulnerability to flood along Ginfle watershed and their hazard manipulate techniques motive and effect of flooding with inside the town of Addis Ababa with unique connection with the families residing alongside Ginfile river.

To cope with the theoretical views of this examine and to cope with the goal, objectives, studies questions, a realistic world view is adopted, which permits more than one techniques to research with multi-lens cognizance and proffer distinct solutions to investigate questions.

For this layout quantitative information have been accrued questionnaire and analyzed. As depicted via way of means of Ennew (1994. The researcher hired extraordinary gear for the information credibility. Therefore this examine adopts a triangulation of studies techniques to conquer non-public biases and so it was beautify the validity of findings and barriers that stem from the usage of a unrelated approach survey studies techniques of quantitative and qualitative have been used.

The examine adopts a twin combined techniques sequential explanatory layout via way of means of combining a quantitative approach with inside the shape of a family survey and qualitative techniques which contain institution discussions with inside the decided on city groups and face-to-face intensity interviews.

The sequential explanatory approach includes series and evaluation of quantitative and in the end qualitative information in successive phases. Both quantitative and qualitative information are incorporated to offer a higher expertise of the determinants of city settlements' vulnerability to flood risks (Creswell, 2014).

This examines might to evaluate the vulnerability of flood and effect of flooding with inside the town of Addis Ababa with unique connection with the families residing alongside Ginfile watershed. This study hired each qualitative and quantitative procedure. The use of quantitative and qualitative procedures in integration affords a higher expertise of studies trouble than both methods alone. The combined techniques studies layout provide a much wider image via way of means of growing the intensity and perception given via way of means of numbers inclusion of discussion and narratives (O'Leary, 2010).

3.2.1. Sampling selection techniques

3.2.1.1. Household surveys

The two stage sampling method which consists of purposive and systematic random technique was used to select the study area and identified households respectively. The two-stage sampling processes are discussed below:

First stage: - involved selection of one flood prone area to represent each stratum or sub group (residential) of the city. Based on this Ginfile watershed is selected purposively as research area which are located in Addis Ababa city particularly in Arada sub-city and provides a good context

for a flood vulnerability study because the area particularly considering the long history of flood disasters that give birth to unequal social and spatial flood vulnerability in the city. The rationale for the choice of Ginifle watershed was due to the unprecedented Jun to August 2019 flood disaster that caused the resident to deaths in the city and destruction of properties and public infrastructure.

Two stage: - at this stage systematic random sampling are used to select the household from a list available in the sub –city ketene administration. A decision was made to cover a total of 215 household since the size was believed to be large enough to undertake the proposed study. As one of the objectives of the current study was to compare the city along different variables, the total sample was distributed evenly among the ketenas.

Thus from each selected study ketena 215 household were selected for the survey irrespective of their total proportion. Participation was voluntary all respondents could decide whether to be involved in this study. For instance in households' survey each participant was given a copy of a participant information statement clearly stating the purpose and goals of the study their right to withdraw at any time.

3.2.2. Sample size determination

Ginfile River is highly vulnerable to flood. Based on this the study applied a sample size determination equation by Yemane formula ((1967) from the total number of 470 household who live in the study area a sample size of 215 household were selected. Usually in social science research the 'e' is taken in a precision level of 5% to 10% depend up on the nature of the study. Here the 'e' is fixed at 7% is used. Therefore for population 470 the required sample sized is 215 Where population size = 470

Where n= designed the sample size the research use

N = designed total number of interviewed street children

e = designed marginal error or degree of accuracy 8%

$$n=\frac{\mathbf{470}}{\mathbf{1+470(0.05)2}}=\frac{\mathbf{470}}{\mathbf{1+470\ (0.0025)\ 2}}=\frac{\mathbf{470}}{\mathbf{1+470\ (0.0025)}}=2\mathbf{15}$$

3.2.3. Data source and methods of data collection

3.2.3.1. Source of data

This study employed both qualitative and quantitative data collected from primary and secondary sources. Quantitative data from primary sources were collected through household survey while qualitative data were collected through key informant interviews and focus group discussions.

3.2.3.2. Data collection techniques.

The following data collection techniques were used to collect the primary data used focus group discussions and Key Informant Interviews.

3.2.3.2 .1 Primary data source

3.2.3.2.1.1 Interview (I)

Semi-structured interview schedule was used to collect the data from the selected respondents. The instrument was first developed in English and then translated into Amharic for the purpose of avoiding ambiguity. Three enumerators were selected based on their experience on data collection and ability to speak Amharic language and knowledge of the study area. Before data collection all the enumerators were oriented and trained for one day about the methods and procedure of data collection content of interview schedule and how they should approach the interviewe before the actual data collection. The schedule was pre-tested with 30 household along Ginfle watershed randomly selected who were not part of the sample respondents. Then necessary additions, deletions, modifications and adjustments were made in the schedule on the basis of experiences gained from pre-test.

3.2.3.2.1.2 Focus Group Discussions (FGD)

Focus group discussion also used to get more information about the issue of the research. FGD is one of a data gathering tools in which groups of people meet to discuss their experience and thoughts about specific topics with each other and the researcher (Crang and Cook, 2007). The existed flood control and watershed management practices around the hilly areas in/around Addis Ababa and flood prone areas in Addis Ababa covered during the interview.

Some households living along Ginfile river well officers selected purposively for then interview groups under study. Some households living along Ginfile river were selected purposively. On

this ground participants for FGDs were asked their willingness and the time for FGD was arranged at that time based on their consent. Factors of flooding effects along Ginfile river in Addis Ababa was the main topics of discussion.

3.2.3.2.1.3 Key Informant Interview (KII*)*

Focus organization dialogue extensively utilized to get greater records approximately the problem of the research. FGD is certainly considered among information accumulating gear where in organizations of human beings meet to discuss and mind approximately unique subjects with every different research (Crang and Cook, 2007). Residing alongside Ginfile river as nicely officers selected purposively for then interview organizations families residing alongside Ginfile river had been decided on purposively.

Key Informant Interview (KII) contains interviewing human beings who've especially knowledgeable views on an element of this system being evaluated. Key informant interviews are "qualitative in-intensity interviews of 15 human beings decided on for his or her first-hand understanding approximately a subject of interest. Interview is the maximum normally used qualitative method that may offer wealthy assets of information on human beings' experiences, opinions, aspirations and feelings.

3.2.3.2.2 Secondary data source

A researcher collected the data for a particular research and then made available used by another researcher. To gather secondary data for the study the researcher was used to gather from Ethiopia National Meteorology Agency data and Ministry of Water and Energy data to explain vulnerability of flood along Ginfle watershed.

3.2.4. Techniques of data analysis

The qualitative and quantitative facts accumulated had been analyzed sequentially in line with the studies layout of this study. The triangulation of thoughts from distinct resets establishes "approach of refining, broadening and strengthening conceptual linkages. In line with the above submission the writer has used a blended strategies technique to cope with the studies questions of this study.

The Statistical Package for the Social science (SPSS) utility changed into the statistical device used for the questionnaire and interviews facts analyses. The facts accumulated from interview time table technique changed into analyzed and provided descriptively through the statistical evaluation that is restricted to descriptive statistics i.e. description of frequencies and percentages, mean and popular devotion tabulation, narration and summarization has made. In order to realize the clean nature of the problem investigators pressured to apply the above noted facts evaluation mechanisms.

3.2.5. Analysis of qualitative data

Data evaluation in qualitative studies is described because the procedure of systematically looking and arranging the interview transcripts, commentary notes or different non-textual substances that the researcher accumulates to growth the expertise of the phenomenon. The procedure of studying qualitative statistics predominantly entails coding or categorizing the statistics. Basically it entails making experience of massive quantities of statistics via way of means of lowering the quantity of uncooked data observed via way of means of figuring out extensive patterns and eventually drawing which means from statistics and in the end constructing a logical chain of evidence.

The qualitative statistics have been gathered sequentially all through the fieldwork additives of the studies. The position of the focal point businesses as guided conversations changed into decorate the expertise of the translation and validation of section one effects from households' surveys. The key specialists and informants' interviews supplied particular data approximately their mind and evaluations in my view skilled citizens or specialists concerning the consequences of each family surveys and consciousness businesses.

Qualitative strategies in addition problem the difficulty of flood vulnerability to resolve the motives why city citizens skilled unequal vulnerability to flood hazards. In this study consciousness institution discussions and interviews and transcribed and all of the data accumulated into written documents. The transcription approaches in addition assisted the researcher to familiarize himself with the gathered statistics from each qualitative strategy.

3.2.6. Indicators for vulnerability to floods

A Flood Vulnerability Index (FVI) would apply to diploma the quantity of flood vulnerability. The FVI method uses three factors of flood vulnerability, exposure (E), susceptibility (S) and resilience (R). Exposure and susceptibility absolutely have an impact on vulnerability even as resilience negatively impact of vulnerability. Because of exposure, susceptibility and resilience have strength on flood vulnerability. Indicators belonging to exposure and susceptibility growth the FVI therefore located within the numerator. Indicators belonging to resilience decrease the FVI therefore they would be located within the denominator (Quang et al. 2012).

An index is a quantitative score size (Cutter et al. 2013) that can be acquired with the useful resource of the use of combining variables consistent with positive rules (Sullivan et al. 2005). Nowadays in disaster studies there had been appreciably used indices. The use of indices in disaster studies simplifies the complex information proper right into a single value (Cutter et al. 2013, Cutter et al. 2008)

Indicators worked as a tool of choice and insurance making in such studies. Indicator desire is most crucial in vulnerability assessment. Vulnerability is often measured every in quantitative and qualitative ways (Birkmann J, 2007). Absolute size of vulnerability using some symptoms and symptoms is not an easy task due to information limitation (Borden et al. 2007, Cutter et al. 2010). That's why some researchers have observed proxy symptoms and symptoms to assess vulnerability in their studies (Qasim et al. 2017).

The vulnerability of this test region would become determined through the use of proxy symptoms. The variables' effects were calculated as possibilities to avoid complications associated with using a couple of devices of size. Table 1: consists of the recognized vulnerability symptoms and symptoms used in this study. A flood vulnerability index (FVI) becomes carried out to degree the volume of flood vulnerability.

Indicators labored as a device of choice and coverage making in such research. Indicator choice is maximum essential in vulnerability assessment. Vulnerability is frequently measured each in quantitative and qualitative ways (Birkmann J, 2007).

Absolute dimension of vulnerability the use of a few signs isn't always a smooth venture because of statistics limitation (Borden et al. 2007, Cutter et al. 2010). That's why a few researchers have followed proxy signs to evaluate vulnerability of their studies (Qasim et al. 2017). The vulnerability of this have a look at place became decided via using proxy signs. The variables' outcomes had been calculated as chances to keep away from headaches related to the use of a couple of gadgets of dimension. Table 1 carries the diagnosed vulnerability signs used on this research.

Vulnerability=Exposure +Susceptibility -Resilience

Table 1: **Vulnerability assessment indicators and their associated variables**

Indicators and their variables	**Community Weightage**	**Explanation**	**Justification impact of vulnerability**
Exposure			
Past flood experience	96	The percentage of households who have been impacted by floods in the past	Prior flooding experience increases flood vulnerability, +
Location of HH	98	The percentage of housing units constructed adjacent to flood-prone rivers.	those who live near river and seashore locations are more susceptible to flooding, +
EVI			
Sensitivity/Susceptibility			
Poor building material	95	The percentage of housing units made of mud	Flood-prone houses are created from mud, +
Disabled people	41	The percentage of the population with physical or mental disabilities	Mobility and evacuation are hampered by physical and mental disabilities, +
Dependents	37	Percentage of dependent population >64 years plus percentage of Population <15 years	Larger numbers of dependents increase the community's vulnerability to floods, +
Illiteracy	60	Percentage of illiterate population	A greater illiteracy breeds more vulnerability, +
Human loss	40	Percentage of population have lost due to flooding from HH	Loss of a human power from household increase vulnerability, +

SVI			
Adaptive capacity			
Flood warning Information about extreme weather condition	80	Percentage of HH got the flood forecasting timely	Early forecasting reduce vulnerability, −
HH access to credit facilities	62	Percentage of HH who have life insurance	Credit facilities access decrease the vulnerability, −
Social networks	65	Percentage of population that have membership in any organization	More social capital means less vulnerability, −
Education	70	Percentage of population that have high school education	An educated community is less vulnerable, −
Working age group	50	Percentage of population from age group 15–64	Active people decrease vulnerability, −
HH Income	75	Percentage of households above poverty line	People above poverty line are less vulnerable to flood hazards, −
Multiple income sources	30	Percentage of population with multiple	People with diverse income streams are less vulnerable to floods, −
Employment	80	Percentage of population employed	Employed are less vulnerable to floods, −
Average vulnerability index			
Composite vulnerability index (CVI)			

Source from the Household (2021)

3.2.7. Ethical considerations

According to Crandall et al (1978) ethical principles on social research and transgressions of the principles revolve around four issues namely harm to participants, lack of informed consent and inversion of privacy and deception of participants. The researchr was fully aware of anything that can compromise adherence to ethical standards equally compromise the validity of the study findings.

The researcher sought informed consent from respondents prior to the interviews. The interview was take in place in socially approved setting and conducted in consideration and honor of

community values and norms. Respondents were assured of confidentiality of their responses and that information was not being used for anything else other than the purpose for which they were interviewed.

In respect of confidentiality individual identifications have been removed from the findings. The researcher upheld these principles in the following ways:

1. Before data was collectd the researcher explained to the participants the aims of the study and then invited them to ask any question that was not be clear before they will be asked for their informed consent.
2. The respondents were assured that the information given is kept confidential and their name was not included in the final report.
3. Throughout the thesis report writing stages avoid plagiarism and attributes appropriately the information taken from secondary sources. The findings are reported as accurately and truthfully as possible in order to avoid fraud.

CHAPTER FOUR- RESULTS AND DISCUSSIONS

4.1. Results

This chapter presents assessment of flood risk and mapping areas in Addis Ababa in general and ginfle watershed area in particular. This chapter gives some general details on topography, climate, hydrology and flood patterns of Addis Ababa city in Ginfle watershed which is relevant in the context of this study on floods vulnerability. Details on the design of the survey sample brief description of the survey areas and some basic assumptions on the data set are also revealed in this chapter. Descriptive results as well as demographic and socio - economic characteristics of flood vulnerability households among the study area as shown in this chapter.

The labeled maps had been assessed and as compared with a referenced record. The vulnerability of Ginfile catchment to flooding turned into additionally analyzed via way of means of the usage of GIS-primarily based on mapping approach weather change.

According to the **figure 1** beneath end result locating there are sturdy correlations among rainfall quantity and river discharge numerous of the number one stream on this element are referred to as kebena. This day of the 12 months is characterized via way of means of dark, cold and moist days and nights. Other seasons (autumn and spring) are incredibly dry. Particularly iciness (December, January and February) are very dry in Addis Ababa. The autumn appears a transitional duration among the moist and dry seasons.

Ginfile movement floods are due to lengthy intervals of rain with inside the catchment vicinity that bring about a boom the water stage of the river and the overflow of river banks each in city and rural areas. Mid-November to January is a season for infrequent rain. The highland weather areas are characterized via way of means of dry winters and dry season in Addis Ababa. According to the records from National Meteorology Agency (NMA) of Ethiopia at some stage in this season each day most temperatures are generally now no longer extra than 23°C and the night-time minimal temperatures can drop to freezing.

National Metrology Agency at summer time season 60.94% rain fall boom than spring, 19.54%, Autumn, 15.3% at some stage in ice 4.22% this suggests that on the summer season from July _September flood vulnerability was highly affected area by flood. Flood threat control method

and early caution device at longitude of 38.7-38.9 and range 8.9 rain fall in a season at range 9.1 and longitude 38.9 relatively liable to flood provided beneath in **figure 1.**

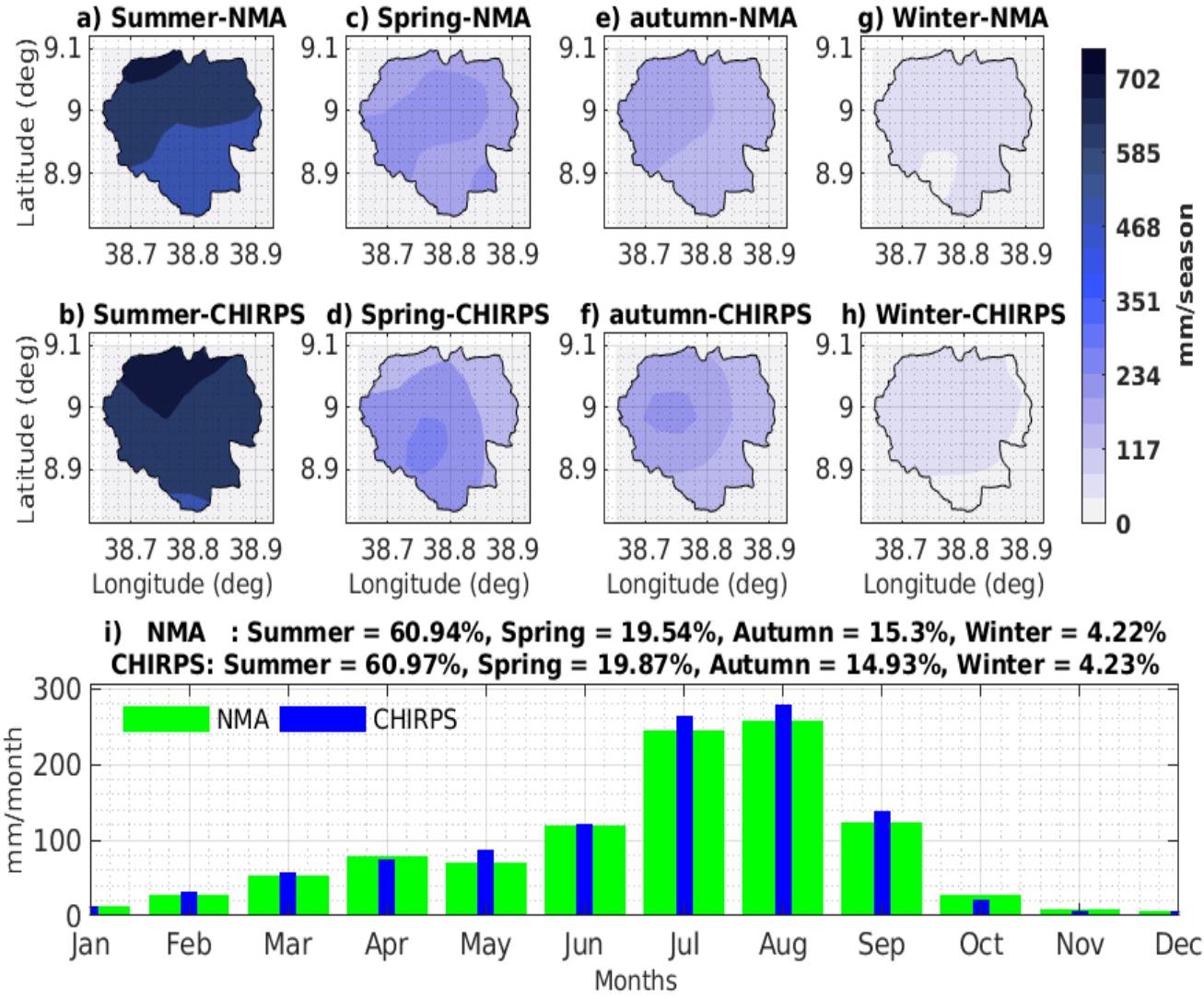


Figure 4:Mean Monthly Temperature (Minimum and Maximum) and Rainfall (1986 - 2016)

Source: Computed based on raw data obtained from NMA)

According to table 2 finding at the summer gauge1 rainfall increase throughout the year this indicated that people at the summer time more vulnerable to flood along ginfle water shade.

Table 2: Rain fall 1989-2018 along Ginfle watershed area (source NMA)

Seasonal rainfall Distribution	R2-stat	F-stat	p-value	Err variance	Variance	Poly slope
Summer-gauge1	0.07398	0.2516	0.6328	2971	2793	-0.395
Spring-gauge1	0.06205	2.201	0.1525	2153	21503	-0.213
Winter-gauge1	0.07776	2.96	0.06576	239.2	277.9	-0.1087
Autumn-gauge1	0.002101	0.002332	0.7523	683.1	720.3	0.0155
Summer-chirps	0.0007630	0.04853	0.7969	2116	1907	0.1172
Spring-chirps	0.002007	0.07110	0.79826	1553	1050	-0.1451
Winter-chirps	0.04313	2.2111	0.1407	227.6	233.7	-0.2887
Autumn-chirps	0.008266	0.2086	0.7123	510.8	511.4	-0.1101

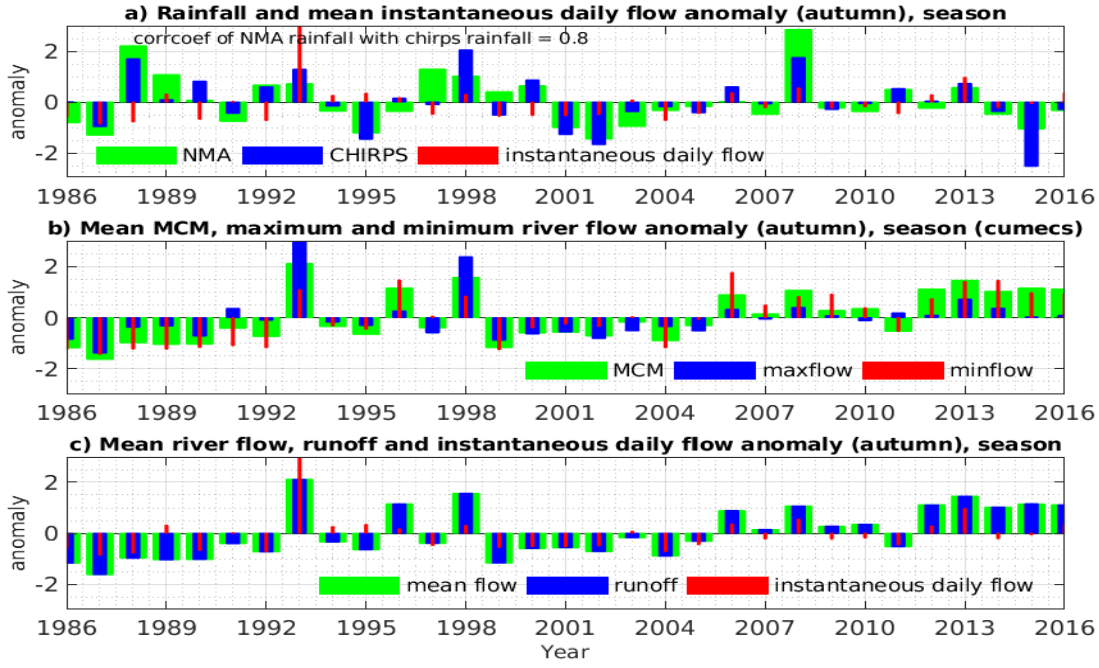
As the data in the figure **2**, shows that the major wet season in Addis Ababa is between Jun to mid-September. It is this time (particularly in July and August) this is the major rain season.

The data in Figure **2** below indicates that the major wet season in Addis Ababa is from June to mid-September. It is this time (particularly in July and August) that flooding is enormous in Addis Ababa. Rivers and stream from the surrounding hilly areas (particularly from Entoto) flood increase along Ginfle the data obtained from secondary source of.

The vulnerability of Ginfile catchment to flooding was also analyzed by using GIS-based mapping technique. As shown in the map the area covered by red colored is found to bet very highly vulnerable.

In **figure2** explained that GIS data compare three season that are, spring, Autumn, summer in this 3 season compared river flow, rain fall and mean instaneous daily flow anomaly (spring) season the year from 1986-2016 anomaly rainfall and daily flow rate indicated that instaneous daily flow increase from year to year this showed that according to NMA data in spring season chirps rain fall =0.91, maximum and minimum river flow anomaly in spring with the minimum river flow = -0.328 this indicated by the figure by red color and indicated by blue color the Vulnerability low in spring season than other season. The comparison between mean river flow, run off and instaneous daily flow anomaly river flow and run off increase from year to year that indicates in the figure.

Rain fall and mean instaneous daily flow anomaly (Autumn) season higher in(Autumn) season based on NMA data the rain fall =0.8. In summer season rainfall, river flow and daily flow rate mean value higher in summer season rain fall=0.791, daily flow=0.338, river flow =0.405 with run off=0.406 this indicated that in summer season need serious concern the data showed in figures below.



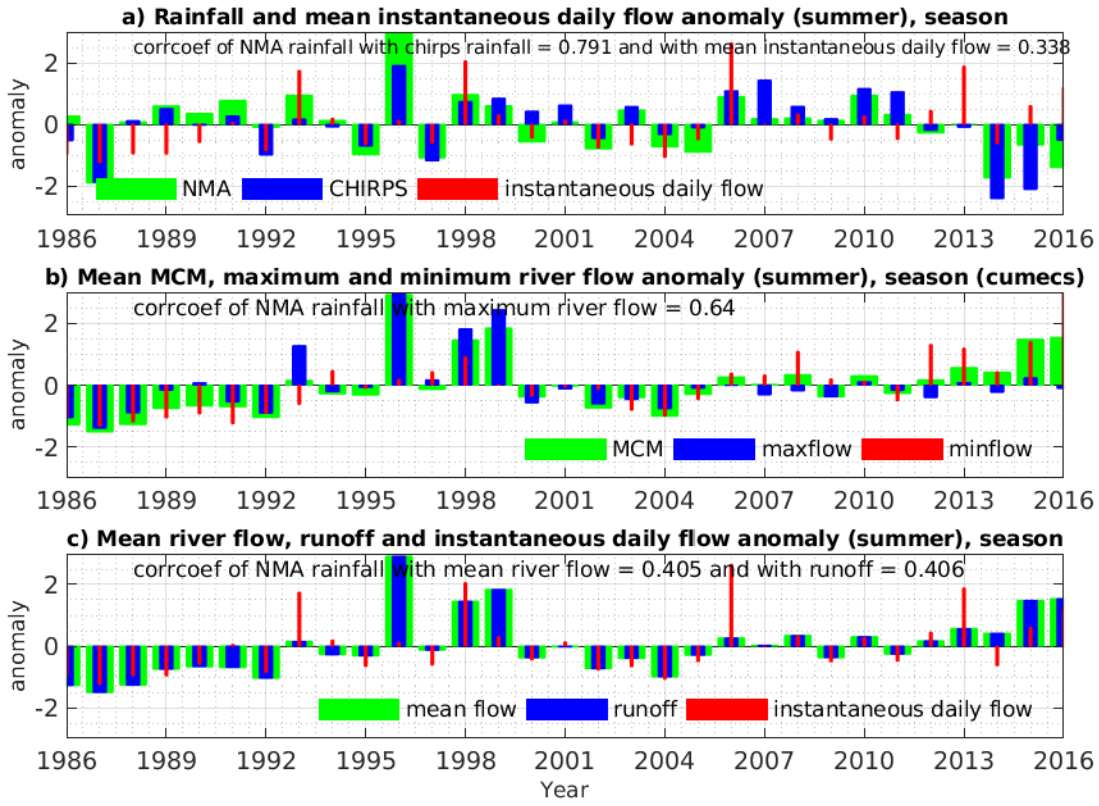


Figure 5: Rainfall (1986 - 2016)

(Source: Computed based on raw data obtained from ministry of water and energy ministry)

4.1.1. Socio-demographic status of the respondents

The demographic characteristics of the household that participated in this study were analyzed to understand the profiles of the household. Key variables analyzed were; age, sex, Education, income and other necessary variables for this research.

4.1.1.2. Age of head of household

The survey result **table 3**, show that the minimum and maximum age of the respondents ranged from 23 to 68 years old respectively were represented with slightly larger numbers in the highest age bracket 18-40 and 41-68 categories. The mean age and SD of the children were 44.10 (SD. = 12.143) years. The oldest age bracket was 68 and above years which accounted for 71(13.5%) of

the respondents. The proportion of ages of males to females was about 43.8% and 56.2% in all age groups.

Table 3: Distribution of respondents by age (n = 215)

Variable	Mean	SD	min	Max
Age of the respondent	**44.10**	**12.143**	**23**	**68**

Source: Field Survey 2021

4.1.1.2. Respondents' sex

Sex is one of the demographic characteristics as presented in **table 4** the majority of respondents 132(61.4 %) were male and 83(38.6 %) only were female.

Table 4: **Distribution of respondents by sex (n =215)**

Variable	Category	Frequency	%
Sex	Male	132	61.4
	Female	83	38.6
Total		**215**	**100**

Source: Field Survey, 2021

4.1.2. Marital status of household

The findings of this study showed that majority the respondents 152(70.7%) were married and living with their spouses, **Table 5**: 38(17.7%) were widowed, 25 (11.6%) were single.

Table 5: **Distribution of respondents by marital status (n =215)**

Variable	Category	Frequency	%
Marital Status	Single	25	11.6
	Married	152	70.7
	Windowed	38	17.7
Total		**215**	**100**

Source: Field Survey 2021

4.1.2. Household family size

Household family size is one of the most important variables. Those household who have active family member have more opportunity to overcome flood hazard and flood risk vulnerability than those household who have less/few family member. **Table 6** shows that the majority of the household 48.6 % have family 3 people in the family and 1.9 % only greater than 6 people. It is inferred that the households that have families have huge responsibilities of taking care of other people other household members (for example, children) or even property in such circumstances as during disasters while the single or separated or divorced may not see the need to take precautionary measures because they do not have any other person other than themselves to care about and may develop 'I don't care attitude.' Thus issues of individual well-being are only determined by an individual.

Table 6: **Distribution of respondents by family size (n =215)**

Variable	Category	Frequency	%
Family Size	1 person	1	2.3
	2 person	20	9.3
	3 person	40	48.6
	4 person	93	43.3
	5 person	53	24.7
	Greater than 6 person	4	1.9
Total		**215**	**100**

Source: Field Survey 2021

4.1.3. Education status of respondents

Education is one of the basic needs of children and all children have the right to get it. The type and levels of education which a street child attained may differ from one child to another.

According to the chart below the majority i.e. 21.9 % of the total respondents did not accomplish their elementary school and from this 48.2 % of the respondent street children's educational level is between grades 1 and 4 are 38.3 % are attaining grade 5 - 8. There are only 5.7 % of respondents whose educational status is high school education. There are 4.3 % of respondent street children who can read and write without formal education and 3.5 % of respondent street children who cannot read and write. It is also mentioned on the FGD that although none of the participants from the group have any vocational training they have attended at least the primary education compared to their age level.

Table 7: Education status of respondents

Respondent	Frequency	%
Cannot read and write	5	3.5
Can read and write	6	4.3
Grad 1-8	68	48.2
Grade 9-12	54	38.3
College/University	8	5.7
Total	141	100

Source: Field Survey 2021

4.1.4. Vulnerability degree of flood

As noted with inside the introduction variations might also additionally exist with inside the manner human beings reply to excessive occasions and achievement of those measures relying on sure family characteristics together with schooling stages, livelihood sources and profits. When in comparison the volume to which families had been nevertheless experiencing bad results regardless of their measures located a good sized distinction among demographic and socio -economic variable and different factors.

The significance of instructional and profits stages of the respondents in warding off bad results became simply observed. Those who've higher profits and education have much less at risk of flood compared to family who've low profits and schooling level. This might be due to the fact the variations in profits and schooling stages are excessive with inside the studies area. The primary supply of livelihood and the achievement of measures taken to keep away from bad flood results.

4.1.4.1. Results of household vulnerability index

Mean values were used to interpret the results of vulnerability indices. So, 0 was considered a low vulnerability, 0.5 was considered a medium vulnerability and 1 was considered as high vulnerability. The areas showed high vulnerable to flood.

4.1.4.2. Exposure index

The exposure index consists of two variables past flood experience of households and household location from the river). The exposure indices for past flood experience is 0.97 and household location from the river 0.99. The calculated exposure indices were high because more than 0.98 % of the people in this area had previously experienced flooding. Moreover most of the population had to live near the river Ginifle and face the devastating consequences of the flood.

4.1.4.3. Sensitivity/Susceptibility index

Several variables had been used to calculate the sensitivity index display that Poor constructing substances in production 0.97. This additionally showed by interview given. They preserve to warfare for my part to construct their residence again a chunk through bit with our little resources. There is not any assist from the government. Many occupants have left their dilapidated unique homes permanently. They can't have enough money to construct their conventional homes again." "The gift hassle of residential homes with inside the town is setting stress on unplanned boom of the town and negative great of life. Moreover excessive populace boom, municipal ineffectiveness and excessive fee of production substances low stage of earnings and saving, scarcity of infrastructure and absence of monetary sources contributed loads for the contemporary hole among call for and deliver of residential homes.

The cost of prone index for disabled human beings in families 0.7 structured human beings (human beings below the age of 15 and those over the age of 64) in families 0.90 for illiteracy 0.5 primarily based totally at the FGD the families' know-how the vulnerability of flood are very low. They have a low belief of flood disasters maximum of them are ignorant the bulk are illiterate with low socio- monetary profiles now no longer they all concentrate to message transmitted through hazard catastrophe prevention approximately destiny weather primarily based totally flood hazard.

They strongly trust that over time they've survived that they'd skilled flooding came about with inside the beyond few years. Many of them will say in which must we go? Moreover a number of them will say we might as a substitute opt to be washed away through flood than leaving. The family live in Ginfile watershed place know-how and flood hazard are very low. They have a low belief of flood disasters, maximum of them are ignorant. The cost of prone index for human loss to preceding floods 0.12 this indicates that the family much less liable to human loss. These variables make a network greater liable to flood.

The sensitivity indices for Ginfile watershed had been 0.8. According to the index all the web sites had been mild to extraordinarily sensitive. The reality in the back of it discovered a sizeable wide variety of structured human beings, especially below the age of 15. Illiteracy additionally performed a crucial function here. Moreover because of preceding floods maximum of them needed to be afflicted by human loss or assets loss which will increase the sensitivity. The great in their homes and neighborhoods are very negative concerning structure, baggy roofs and shortage of centers like potable water, sanitation, drainages and small areas among the homes FGD.

4.1.4.4. Adaptive capacity index

The variables used to calculate the community's adaptive capacity for Ginfle watershed was value of vulnerability were timely/earlier flood warning 0.56 flood warning are considered to be the first stage of the institutional management approach. However household try to forecast forthcoming natural hazards, alongside their frequency and magnitude through their experiences by identifying cloud formation, density, movement, wind speed, direction and contemporary temperature fluctuation rate, household access to credit facilities 0.47, social networking 0.17, working-age group/active people 0.38 the family member are directly involved in the flood disaster preparedness stage to cope with the forecasted damaging rate.

In women's the study in area use indigenous knowledge and skill help their family to cope with natural flood disaster impacts but they need to use these networking skills and self-confidence for increasing the recovery capacity, household income 0.47, multiple income sources 0.3 and employment 0.43, which indicates the moderately high adaptive capacity. Most of the areas received the earlier flood warning forecasted in several ways. Household credit access facilities, social networking among the people and the city were found low in this study.

Household incomes were found to be moderate but the working-age group or the active people group was found to be low. Employment rate map of the study area is presented in Figure 5.14 and shows that the rate of employment of the study area varies significantly from state to state. The value of vulnerable index shows that moderate employment rate (0.43). This made the population of the city to have moderate vulnerability to flood. Higher value of employment rate of this region plays a vital role in making the region safe from economic vulnerability to flood. The involvement in multiple livelihood sources could increase the adaptive capacity which is found moderate. A similar study was conducted (Shah et al. 2018), where they found similar findings to this study. They calculated the adaptive capacity index for Nowshera and Charsadda were 0.48 and 0.55 respectively.

Table 8: Vulnerability indices for the sample sites

Indicators and their variables	**% value**	**VVI**
Exposure		
Past flood experience	93	0.96
Location of HH	95	0.99
EVI		**0.96**
Sensitivity/Susceptibility		
Poor building material	91	0.989
Disabled people	30	0.7
Dependents	33	0.90
Illiteracy	23	0.5
Human loss	5	0.12
SVI		**0.8**
Adaptive capacity		
Flood warning information about extreme weather condition	45	0.56
HH access to credit facilities	29	0.47
Social networks	11	0.17
Education	18	0.26
Working age group	19	0.38
HH income	32	0.42
Multiple income sources	9	0.3
Employment	35	0.43
Average Vulnerability Index		**0.368**
Composite Vulnerability Index (CVI)		

Source: Computed from survey data, 2021

4.2. Discussion

4.2.1 The status level of household vulnerability to flood

Among the 215 respondents 156(72.6%) said that their household are vulnerable to flood. The rest 59 (27.4%) did not vulnerable to flood this indicates that serious concern are need for improvement of flood vulnerable area.

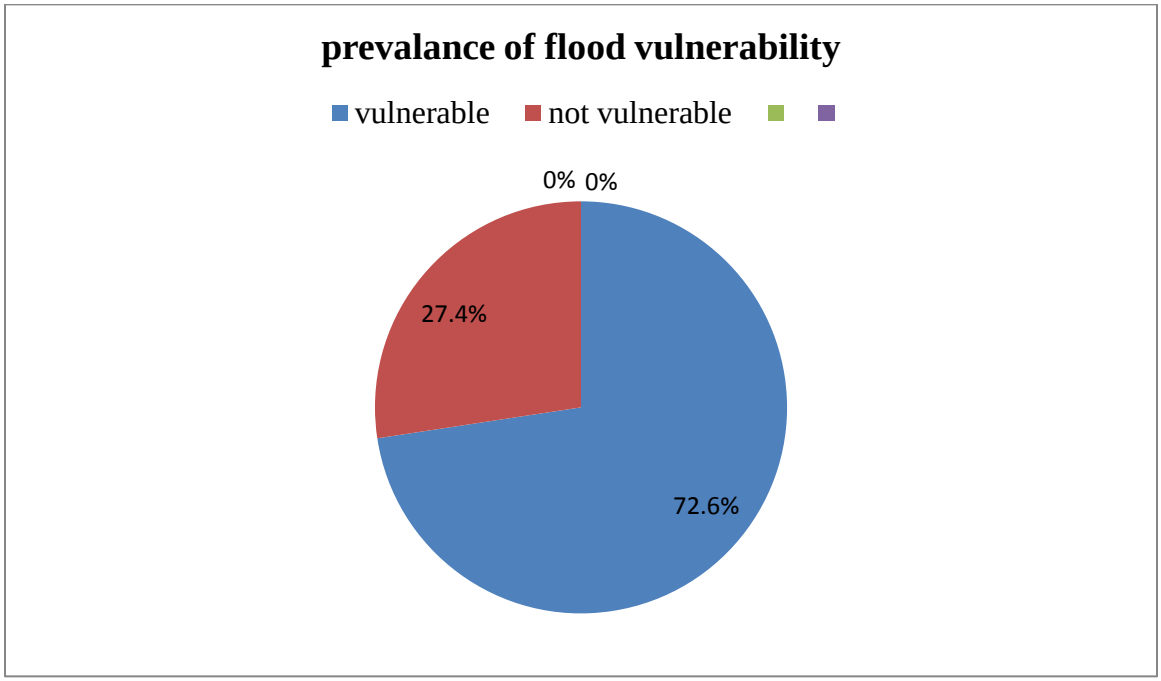


Figure 6: Percentage of flood vulnerability household in Addis Ababa along Ginfle water shad area, Ethiopia from March to April, 2021

4.2.2. The perceive the reason of household vulnerability to flood

According to table 9 below household vulnerability along Ginfle watershed shows that among the 215 respondents 215(100%) said that their respective the main cause of vulnerability was flood risk. Rainfall is other major factor directly associated with flood hazard of the city. Duration, magnitude and intensity of rainfall determine the formation of flood. The survey result of **table 9** shows that, 205(95%) of respondents agreed that overflow of mono river and 10(5 %) heavy rainfall is the causes for city flooding occurring increase in the last decaying.

According to FGD" The household reside near the river Ginfile heavily affected by flood came from road, upper residential house ruff during rainfall and liquid waste from different household."

The frequency and impact of flood occurring increase in the last decaying. According to the respondent's vulnerability of flood in the past 30 years occurring every years 200 respondents (93%) respond. Flood duration occurred for long time according to the respondent idea 215(100%) respondents height of flood 82(38.1) medium; high 15(7%) of their respondent, small height small 118(54.9%) of the respondents respond most of the household vulnerable to flood according to the respondents most of the time 215 (100%) aware of risk of flood specially at the summer time no warning about flood the government not give immediate response.

Flood is considered a significant threat to the development of the country as well as in the study area and high damaged infrastructure. In the study area floods are adversely affected both in the environmental and ecological aspects when the respondent response**.** Based on the FGD"Our drainage systems have been blocked by different kinds of wastes that our people use to dump on the drainage line because most of us don't have waste disposal bin to dump refuse this aggravate the vulnerability to flood."

Table 9: Cause of household vulnerability along Ginfle water shade area Addis Ababa, Ethiopia from March to April, 2021

Variable	frequency	Percent
Hazard affect community last 30 years Flood	215	100
Cause damage Flood	215	100
Cause of flood Heavy rainfall Overflow of mono river	10 205	4.7 95.
Frequency and impact of flood occurring increase in the last decaying Yes	215	100
Number of flood in the past 30 years None Every years	15 200	7 93
Your household affected by 30 years Yes No	59 156	27.7 72.6
Flood duration Long time	215	100
Height of flood in your house hold High Medium	15 82	7 38.1

Small	118	54.9
Flood magnitude compared to other flood		
equal	104	48.4
more	111	51.6
Your household often affected by flood		
Yes	121	56.3
No	94	43.7
Aware of risk of flood		
Yes	215	100
Information or warning about flood straight		
Yes	5	2.3
No	210	97.7
Way of information passed		
Traditional way	215	100
Present in aware of flood		
Yes	68	31.6
No	147	68.4
Preparation to remove flood		
Yes	159	74
No	56	26
Method used to reduce the effect of flood		
Yes	215	100
Gain help from household or other institution		
Yes	130	60.5
No	85	39.5
Value of government response during and after flooding		
Immediate	130	60.5
Inadequate	85	39.5

Source from survey 2021

4.2.3. Intervention and risk management strategies in alleviating flood hazard

According to the finding in table 10 below this the respondent explained that future intervention and risk management strategies in alleviating flood hazard along Ginfle water shade the harsh adverse impacts of flooding usually calls for managing flood disaster through appropriate systems and strategies is necessarily required especially to predict and evaluate possible flood that may occur in a particular area. It is always argued that to find out possible solutions to flooding problems, an understanding of the long-term factors that contribute to increase flooding are important including unplanned urbanization, soil erosion and deforestation.

Then to mitigate flooding hazards it is important to adopt watershed-based management practices In addition to this, to mitigate flooding propensity, adopt watershed-scale best management

practices which includes floodplain zoning, planned urbanization, restoration of abundant channels, dredging of rivers and, establishment of buffer zones along rivers, controlled runoff near construction sites, adjustment of life-style and , good governance and improvement in flood warning/preparedness systems**.**

Risk management strategies attend training in flood risk management strategies from 130 (60.5%) respondents not attend training in flood risk management who give information /warning /training by local government 215(100%) of respondents most of the time poor drainage and poor water management technique. Show below in **table 10**:

Table 10: **Intervention and risk management strategies along Ginfle water shade Addis Ababa Ethiopia from March to April, 2021**

Variable	frequency	Percent
Attend training in flood risk management strategy Yes No	 85 130	 39.5 60.5
Information/warning /training/ Local government	 215	 100
Usefulness of information you received No Yes	 215 -	 100 -
Committee available in flood management No Yes	 215 -	 100 -
Anticipate in occurrence of flood No Yes	 215 -	 100 -
Your household able to evaluate in flood No Yes	 215 -	 100 -
Place you shelter during flood Yes NO	 59 156	 27.4 72.6
Place of shelter Relatives	 215	 100
Government or other institution provide prevention No Yes	 215 -	 100 -

Value of government or other institution in preparation for flood In adequate	 215	 100
Got help from government or other institution after flood No Yes	 215 -	 100 -
Community support mechanism to address flood risk No Yes	 215 -	 100 -
Recovery experience after flood No Yes	 215 -	 100 -

CHAPTER FIVE- CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The central focus of this research has been to assess the households' vulnerability to flood alongside Ginfle watershed and their threat control strategies in Addis Ababa city, Ethiopia. This paper has presented a quantitative methodology through Participatory vulnerability approach to understand the household to flood vulnerability in ginfle watershed. The method employed descriptive statistical tools of frequency counts and percentages to analyze various categories of variables. Results show that household in the study area are mostly at risk of flood hazard. A flood is a natural disaster and causes loss of life and property destruction. In Ethiopia flooding suffering from many causes like heavy rainfall during four summer season (June, July, August and September) high elevation topography and land use system involves clearing the land of its native vegetation and altering the characteristics of the bottom watershed.

The heavy rainfall was identified as main contributors to flooding in the area. Vegetation works alongside the soil to store rainfall, when that vegetation is cleared, rainfall-runoff can increase substantially. Due to this and other factors the flash flood and river flood are caused to loss many life, economy, and environmental destruction within the country along Ginfle river also cause distraction. Calculating their corresponding components, exposure, sensitivity, and adaptive capacity have all been measured. The composite vulnerability indices provide the overall vulnerability scenario of an area. A study reveals that the selected area was highly vulnerable to flood.

The flood hazards problems are getting worse in the coming years due to the massive construction of houses, buildings and roads and less attention to river side drainage and catchments. Moreover the city isn't showing enough concern about population settlements residing along the stream and effects of flood the ecological, environmental, social and economic impacts of flood variability. The hazards on the city households residing along Ginfile watershed floods effects in the study area are one of the most dangerous and frequent catastrophes assessing households residing along the stream and river sides.

5.2. Recommendation

Based on the findings of this study the following issues are recommended to minimize the vulnerability of households to flood hazards residing along Ginfile stream.

Based on the qualitative and quantitative findings, the following short term and long term actions are recommended for policy makers, the Urban Land Administration Offices of Addis Ababa, government and researchers.

For urban land administration offices of Addis Ababa.

- Shall work on the fact that the river and river side offices must come up with a proposal to upgrade the infrastructure in the flooded area in terms of building of new barrier catchments, re-capacitating of the existing catchments, roads and the drainage by implementing plan with timelines to deliver on them to avoid the flood risk and give rapid response.
- Land use planning and building zoning should be practiced in the study area and other

  Measures such as prohibiting agricultural encroachments towards rivers, constructing easily accessible flood shelters in order to reduce the vulnerability of people should also be practiced.

For Ethiopian Meteorology station

- Should adopt an early warning system by using geographic information systems and remote sensing techniques in monitoring and managing urban land changes and its proper implementation. That has been proven to assist with the procedures to collect and analyze spatial data for hazard and risk assessment.
- Providing accurate weather forecasts of the severity and intensity of rainstorm and accurate prediction of flood levels in rivers helps government and the public in making decision of evacuating valuable properties from flood hazard zones.
- Early warning systems and proper dissemination of information on flood occurrence and intensity reduce life and property losses. Furthermore, timely mitigation and preparedness measures should be implemented in high to very high risk areas of the study area in order to reduce the aftermath of the flooding.

For Addis Ababa city administration should:

- The city administration needs to consider the construction of permanent structure to protect the city people from flooding in particular in ginfile watershed area.
- The communication method at kebele administration level is should well organized.

For the researcher

- The researcher's follow-up research endeavors must be considered and the effects of household vulnerable to flood risk area to better understand the nature, timing and causative agents of floods as well as the extent of area that will experience inundation of flood waters.

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ANNEX

ANNEX 1: **Questioners for assessment of households' vulnerability to flood along Ginfle watershed and their risk management strategies, Addis Ababa, Ethiopia.**

I am a student at the University of Addis Ababa, 6 kilo pursuing a Masters in food security and developmental studies. I am collecting data for a research study in Arada sub city along ginfle watershed area district. The study focuses on assessing house hold vulnerability to flood in the area. I would like to ask you some questions about your family. The data that you provide is for academic purpose and it will be kept strictly confidential. This is voluntary, you can refuse to answer to some of the questions but I hope you will accept as your views are very important. Please use (X) sign for selection.

Section 1: Susceptibility

1 .Sex of household head

A. Male; |__| B. Female |__|

2. Age of head of household

A. <20ans |__|; B. 20-39 |__|; C. 40-59 |__|; D. 60+ |__|

3. Marital Status of household head

A. Single|__|; B. Married |__|; C. Widowed |__|

4. Education status: highest level of education attained

A. No schooling |__| ; B. Functional literacy |__|; C. Primary schooling |__|; 4.D Secondary schooling |__|; E. Tertiary schooling |__|; F. University |__|

5. Household size

.....a.1.....b .2 c. 3 d. 4 e >5

6. Type of dwelling for the household

A. brick walls with iron/tiles sheet roof |__|; B. Mud walls with iron/tiles sheet roof |__|;

C. Mud walls with thatched roof |__| ; D. hurdle walls with thatched roof |__|

7. What are the main sources of income for the household?

_____

8. What are the secondary sources of income of the household?

_____

Section 2: Households' Vulnerability

1. What are the main hazards that have affected your community during the last 30 years?

A. Flooding |__| B. Drought |__|; C. Storm |__|; D. Bushfire |__|

2. Among those hazard, what were the most damages?

A. flooding |__|; B. drought |__|; C. Storm |__|; D. Bushfire |__|

3. What are the causes of flood in your locality?

A. heavy rainfall |__|; B.Over flow of Mono river |__|; C. Other, specify.....
.....|__|

4. Do you think the frequency of occurrence and impacts of flooding have increased during this decade compared to previous decades?

A. Yes |__|; B. No |__|

5. Number of flood event during the past 30 years

A. non |__| b. >2 times |__| c.>3 times |__| d.>6 times |__| e. every year |__|

6. Was your household affected by the 30 years flood?

A. Yes |__|; B. No |__|

7. Flood duration (the number of flood days during the flood)

A. for long time |__| b. for short time |__|

8. What is the height of the flood in your household? (Flood depth)

A. high |__| b. medium |__| c. small |__|

9. How could you appreciate the flood magnitude compared to the others floods?

A. Less; |__| B. Equal |__| ; C. more |__|

10. Does your household's often affected by floods?

A. Yes |__|; B. No |__|

11. Are you aware of the risk of floods in your locality?

A. yes |__|; B. No |__|

12. If yes why do you still live in such an area?

.....

13. Was there any information or announcement or warning about the threat of floods?

A. yes |__| ; B. No |__|

14 .if yes, from which ways the information is passed

A. TV|__|; B. Radio|__|; C. traditional ways|__|; D. volunteers|__|

15. Were you aware of flood?

A. yes |__|; B. No |__|

16. Were you affected by the flood or any other flood in your locality?

A. yes |__|; B. No |__|

17. Are you prepared for floods?

A. Yes |__|; B. No |__|

18 .If yes what are the methods used?

_____

19. Do you use any method to reduce the effect of flood disasters to your household when they occur?

A. yes |__|; B. No |__|

20. If yes, what are those methods?

.....

21. Do you get help from the government or other institutions during floods?

A. yes; |__| 2. No |__|

22. If yes what type of help?

.....

23. How do you value the government response during and after the flooding in your area?

A. belated|__| ; B. immediate |__|; C . inadequate|__|; D. adequate|__|, other specify..... |__|

Section 3: Risk Management Strategies

24. Did you attend any training on flood Risk management?

A. yes |__|; B. No |__|

25. If yes, what information did you receive during the training?

.....

26. Which structures provide the information/warning/training?

A. Croix rouge; |__| B. NGOs; |__| C. locale government t|__|

27. Was the information you received useful during and after flood disaster?

A. yes |__|; B. No|__|

28. Is there a committee of flood management in your community?

A. yes; |__| B. No |__|

29. If yes, are you member?

A. yes; |__| B. No |__|

30. Are you able to anticipate the occurrence of the floods?

A. yes |__|2. No|__|

31. If yes how?

A. Local indicators|__|; B. early warning system |__|; C other specify..... |__|

32. Is your household able to evaluate, in case of a flood?

A. yes|__|; B. No |__|

33. Are there any places where you can seek shelter during flood?

A. yes; |__| B. No |__|

34 .If yes where is that area?

A. Public school building |__|; B. Neighbor ours or relatives in non-flooded area |__|;

C. church building|__| D. public evacuation site |__|; E. migrate temporarily to other areas less vulnerable |__|; F. Other Specify.....

35 .Does the government or others institutions provide prevention and protection measures?

A. yes |__| ; B. No |__|

36. if yes what are those measures

.....

37.How do you value the ability of anticipation and preparation of the government or other institution to floods?

A. bad|__|; B. inadequate|__|; C. Good|__|

38.Do you get help from the government or other institution after the flood?

1. Yes|__|; 2. No|__|

39.If yes what type of help?

.....

40. Do you have community's support mechanisms to address the flood risks?

A. yes |__|; B. No |__|

41. If yes what are those mechanisms?

.....

42. Do experience environment recovery after flood ?(positive effect of flood on the environment)?

A. yes |__|; B. No|__|

43. if yes what are those effects

.....

44. What do you think the government or NGOs should do as prevention measures to reduce flood impacts on your community?

.....

56.What do you think the government or NGOs should do to respond to flood during flood disaster

.....

57. What do you think government or NGOs should to after flood to help you recover?

.....

58. What do you think the government or other institution should do to control flood Risk

.....

59.What do you think your community itself should do to reduce flood impact on your locality?

Questioner: for Informants Interview.

1. What do you think are the causes of flood? Why?

2. How do you usually deal with flood occurrences and the effects?

3. In which areas of life have floods affected you?

4. How were you affected?

5. Why do you think your community was more affected than any other communities?

6. Were you able to tell that flood would occur?

7. How did you know?

8. Is there any way you are being prepared to deal with hazards

9. Which relief organizations assisted you to deal with floods?

10. Do you think relief organizations are important during flood situations?

11. How and when do they usually help during floods?

12. Do they ever seek your ideas before, during and after helping in flood hazard situations?

13. Does the district have a flood risk management committee?

14. How do you think the community can help itself in managing floods?