PRESBYTERIAN UNIVERSITY COLLEGE, GHANA

FACULTY OF DEVELOPMENT STUDIES

DEPARTMENT OF ENVIRONMENTAL AND NATURAL RESOURCES MANAGEMENT

# FLOODING AND ITS EFFECTS ON THE QUALITY OF HEALTH OF RESIDENTS OF MAAMOBI IN THE AYAWASO NORTH MUNICIPALITY OF THE GREATER ACCRA REGION OF GHANA

BY

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SEPTEMBER 2020

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A dissertation submitted to the Department of Environmental and Natural Resources Management of the Faculty of Development Studies, Presbyterian University College, Ghana in partial fulfilment of the requirements for the award of a Master of Science Degree in Natural Resources Management

BY

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SEPTEMBER 2020

# DECLARATIONS

## Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature……..……Date……..…….....

Name:……

## Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of dissertation laid down by the Presbyterian University College, Ghana.

Supervisor's Signature……Date…….…….….

Name: ……

## ABSTRACT

The occurrences of floods in Accra have become an annual event with severe consequences mostly felt by the urban poor. The study assessed flooding and its overall effects on the quality of life of residents of Maamobi in the Ayawaso East Municipality of the Greater Accra region of Ghana. The study was a descriptive survey and the views of 150 respondents were sought through the administration of questionnaires. Primary and Secondary sources of data collection method were used and data collected from the field was processed and analysed through the use of Statistical Product and Service Solutions (SPSS) version 16.0. Opinions were quite varied regarding the human-induced activities contributing to flooding as majority (42%) of the respondents believed it is poor urban development. It was revealed from the study that 68% of the respondents believed that they experienced flooding whenever there was a heavy rainfall within the Community and 54% often times experienced flooding between May and June of each year. Knowledge and perception of residents about flood are key in solving flooding-related activities within the community. However, the knowledge and perception of respondents on the condition of flood was quite mixed but a majority of 62% of the respondents believe shallow running water is a flood condition. It can therefore, be concluded that the knowledge and perception risk of residents of Maamobi with regards to flooding are quite high; making them to adapt strategies to mitigate flooding disaster. Government should mainstream flood risk management into wider development plan. This can afford local government not to ignore risks, particularly those related to flood, climate change, urbanization and environmental degradation.

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## DEDICATION

I dedicate this work to my family. I say ‘’May Allah bless you all’’.

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

Climate change has emerged as one of the defining issues of the early 21st Century. NASA's Goddard Institute for Space Studies finds that global surface temperatures in the past decade are $0.88^0$C higher than the start of the 20th century, with two thirds of this warming having occurred since 1975 (Hansen, Ruedy, Sato & Lo, 2010). Recent research confirms that the imprint of human-induced Climate change can be recognised in current events (Min, Zhang, Zwiers, & Hegerl, 2011; Pall *et al*., 2011). Climate change is not an occurrence in the distant future, but a phenomenon that is taking place now (Dankelman, 2002). Many reports abound on how climate change is impacting the planet. The Intergovernmental Panel on Climate Change (IPCC) is the main body formed by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP), to assess the scientific and technical information about climate change in a comprehensive, transparent, and objective manner. The IPCC has stated clearly in a report that climate change is inevitable, it is real and happening now and the impact will be felt globally. In its current fifth assessment report, the IPCC defines climate change as, a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties. These changes in the mean and/or the variability persist for an extended period, typically decades or longer (IPCC, 2013). There is a high probability of observed trends, such as increases in heat waves and heavy precipitation events, intensifying over the 21$^{st}$ Century (IPCC, 2007).

Extreme weather and climate events are anticipated to generate significant risks to societies and ecosystems (IPCC, 2012).

Regular floods are part of people's lives in various regions of the world, recurring with varying magnitudes and frequencies to which people have adapted for centuries. These floods are generally expected and welcomed in many parts of the world, since they enrich the soil and provide both water and livelihoods (Rahman, 2014). Usually a flood is an overflow of water that submerges land, low-lying villages and towns or an unusual condition affected by inflow of the tide. Flooding may occur as an overflow of water from water bodies, such as a river or lake, or sea or large natural water basins, or it may occur due to an accumulation of rainwater on saturated ground in an aerial flood (Rahman, 2014). Floods have claimed over 10,000 lives in the United States of America since 1900 (Adeoye, Ayanlade & Babatimehin, 2009). Statistics also show in 1998, floods affected approximately 30 million people in 52 out of 64 districts in Bangladesh mainly as a result of climate change and economic growth in low-lying regions (Khan, Xun, Ahsan & Vineis, 2011). In July and August, 2010, Pakistan was hit by one of the worst floods in their history of disasters rendering 20 million people homeless (Straatsma, Ettema & Krol, 2010). Over 22,000 people in Nepal had to relocate temporarily due to floods. It further stated 46,000 houses were left totally damaged and more than 130,000 hectares of agricultural lands were submerged by floods (Asian Development Bank, 2007).

In 2011, Thailand also experienced heavy rains that lasted nearly 12 weeks claiming over 500 lives in the process. All these reports and studies, illustrates the devastating effects of floods (Orok, 2011). Floods are crucial

national issue as a great number of African countries lack the resources, both financially and technologically, to fight the effects and impacts of flooding (Satterthwaite et al., 2007). Human activities have contributed to global warming through the release of greenhouse gases. Global warming has caused a shift in the Earth climate system and an increase in extreme events such as high temperatures, high sea levels and extreme precipitation are expected in the future (IPCC, 2014). The events could have adverse impact on human society through the risk of human lives and damaged or destroyed economic assets. Many human systems are vulnerable to extreme events and need to be better prepared for climate change impacts to reduce the potential costs of extreme events. This is particularly important in urban areas where large amount of people and assets are located (Skåne, 2013). Climate change adaptation strategies implemented in the development planning is essential to create more robust and sustainable societies (IPCC, 2014; Hallegatte, 2008; Wilby & Dessai, 2010). However, due to the uncertainty in climate change projections *no regret* strategies that provide multiple benefits are recommended, such as green infrastructure (National Board of Housing, Planning and Building, 2010 Hallegatte, 2008; Wilby & Dessai, 2010).

In the perspective of Ghana, floods are annual phenomena with the most severe appearance during the months of June, July and August in every year. Flooding is one of the leading disasters in Ghana and has major impacts on people and their livelihoods. The period between 1968 and 2011, incidences of flooding have killed approximately Three Hundred people leaving over 3 million people affected (Okyere, Yacouba & Gilgenbach, 2012). Flooding also comes with an increase in epidemics especially through the spread of waste, flood water

and the accumulation of water and consequent blockage tends to be conducive breeding grounds for mosquitoes (Feng *et al*., 2007; Messner *et al*., 2007). Among the various types of land use/cover, urban areas have the greatest tendency of modifying the hydrological behaviour of a catchment. The Construction Industry (roads, buildings) accompanying urbanisation creates impermeable surfaces impeding infiltration of water and lead to overland flow leaving urban areas highly susceptible to floods (flash floods) especially when there are bad drainage network systems (Okyere *et al*., 2012).

**1.2 Statement of the Problem**

The frequency of natural disasters has been increasing over the years, resulting in loss of life, damage to property and destruction of the environment (Living with Risk, 2000). Flood losses reduce the assets of households, communities and societies through the destruction of standing crops, dwellings, infrastructure, machinery and buildings, apart from the tragic loss of life. In some cases, the effect of extreme flooding is dramatic, not only at the individual household level, but also in the country as a whole (Integrated Flood Management Concept Paper, 2009). Flood impacts which are mostly due to climate change are now well documented and technological advancement has led to a clearer understanding of future risks and impacts. With increasing urbanization, understanding the impact of flooding upon the urban environment will become ever more important. Evidence is mounting that flood presents unique challenges for urban areas and their growing populations. Where urban areas grow rapidly without regard to current and future resource demands and flood, large numbers of people and their assets can find themselves vulnerable to a range of disruptive and damaging risks (Ruth & Gasper, 2008).

These impacts extend far beyond the physical risks posed by flood, such as sea-level rise and extreme weather events. Cities could face difficulties in providing even the most basic services to their inhabitants as a result of flood. Flooding affect water supply, ecosystem goods and services, energy provision, industry and services in cities around the world. It can disrupt local economies and strip populations of their assets and livelihoods, in some cases leading to mass migration. Such impacts are unlikely to be evenly spread among regions and cities, across sectors of the economy or among socioeconomic groups. Instead, impacts tend to reinforce existing inequalities; as a result, flood can disrupt the social fabric of cities and exacerbate poverty.

### 1.3 Purpose of the Study

Though flood prone communities including Maamobi have benefited from various interventions, much attention has not been placed on the health impact of residents in flood prone areas. On the basis of this the study intends to ensure that the health status of residents of Maamobi should be of prime importance in case of any flood intervention.

### 1.4 Research Questions

1. To what extent are human-induced activities contributing to the flood situation at Maamobi?
2. What is the knowledge of residents of Maamobi about floods?
3. What are the perceptions of residents of Maamibi about floods?
4. What are the mitigation measures adapted by Local and National decision makers?

### 1.5 Research Objectives

The main aim of the study is to assess the impact of flooding and its overall effects on the quality of life of residents of Maamobi in the Ayawaso East Municipality of the Greater Accra region of Ghana.

Specifically, the study seeks to:

1. Determine the human-induced activities contributing to the flood situation at Maamobi.
2. Examine the knowledge which residents of Maamobi hold about flooding.
3. Identify the perception which residents of Maamobi hold about flooding.
4. Analyse the mitigation measures adapted by decision makers in dealing with the situation.

### 1.6 Significance of the study

Cities are key players in the global and regional implementation of adaptation measures to climate extremes, as this is where the majority of people and economic activities are located. The study identified the adaptation measures put in place by the residents of Ayawaso North municipality to combat climate change for that matter flood. The study has also contributed to awareness creation on the impact of urban flooding as result of climate change. The findings add to information available on the impact of climate change in flood management in urban areas and how more practical strategies can be put in place to solve the current challenge the municipality faces with regards to flood. Significantly, the study will inform stakeholders involved in the management of flood at the study area, and their contribution to floods management in the area.

### 1.7 Delimitation of the Study

The study was limited to Maamobi in the Greater Accra region. Maamobi is a flood prone area in the Ayawaso East Municipality and has always been a reference point for the general public whenever it rains. Contextually, the study considered the area due to the intervention made by stakeholders to mitigate the floods. Again, Maamobi was chosen over other areas because it is very well known to the researcher and where access to relevant data was easy to obtain.

### 1.8 Limitations of the Study

This study is expected to encounter some limitations. Some of this limitation encountered during the study included the absence of data from some of the Institutions. Alternatively, data sources like newspapers and magazines were consulted in order to get some relevant information. The ability of respondents to recall situations before the drain construction in Alajo, Accra was very critical. The uncertainties of some respondents were resolved by corroborating the stories from other people within the area of study which is Maamobi.

### 1.9 Organization of the study

The study is organized into five chapters. Chapter One deals with the Background of the study, statement of the problem, research questions, research objectives, scope and justification of the study. The limitations to the study are part of this chapter. Chapter Two of the study covers the review of theoretical principles underpinning the subject matter under consideration. With this, past works pertaining to the topic under study, definition of key concepts, conceptualization of the topic and identification of gaps in policies and previous literature were examined. Chapter Three focuses on the methodology used to

conduct the study. This specifically includes the research design, sampling procedures, data collection and data analysis. Chapter Four discusses and presents the findings from the study. Chapter Five contains the summary of Findings, Conclusion and policy implications for action and recommendations that will inform policy.

# CHAPTER TWO

# REVIEW OF RELATED LITERATURE

## 2.1 Introduction

This Chapter presents the literature review by introducing the key concepts and terminologies that are relevant to this study. Then a review of the related literature is presented on the situation of flooding on the global and local perspective.

## 2.2 Definition of Flooding

Flooding like other environmental hazards can be described as a natural and inexorable process which occurs when a river's channel cannot contain all the water supplied to it by its watershed, that is, the land area that drains into the river. When this happens in the lower part of a watershed, water spills out onto the floodplain immediately next to the river channel that has been built by the river (fluvial) processes. Basically, flooding can also be said to be the situation when water inundates an area usually for a period of time for various reasons. Also, flooding is explained as an overflow of water onto land that is normally dry. It is also explained as an overflowing of water onto land that is normally dry. Floods can happen during heavy rains, when ocean waves come on shore, when snow melts quickly, or when dams or levees break. Damaging flooding may happen with only a few inches of water, or it may cover a house to the rooftop.

There are five types of floods that are currently being studied. These include:

1. Flash floods- a rapid flooding of low-lying areas which washes rivers, dry lakes and depressions. This type of flooding may also be caused by heavy rain associated with a severe thunderstorm, hurricane, tropical

storm, or melt water from ice or snow flowing over ice sheets, or snowfields.

2. Coastal floods- `occurs when normally dry, low-lying lands is flooded by sea waves. The extent of coastal flooding is a function of the elevation inland floodwaters penetrate which is controlled by the topography of the coastal land exposed to flooding
3. Urban floods- caused by excessive runoff in developed areas where the water doesn't have anywhere to go.
4. River (or fluvial) floods- occurs when excessive rainfall over an extended period of time causes a river to exceed its capacity by heavy snowmelt and ice jams
5. Ponding (or pluvial flooding) a type of flooding that can happen in relatively flat areas. Rain water falling in an area is normally stored in the ground and in canals.

Floods have an element of damage that makes it undesirable. Floods may cause damage to lives as well as property. The repercussions of flood on the socioeconomic activities in society may be prevented when appropriate measures are put in place. Nyarko, (2000) describes flooding as the inundation of an area by unexpected rise of water by dam failure or extreme rainfall duration and intensity in which life and properties in the affected area are under risk. Tapiwa, Lubna, Asfaw, Thi and Forba (2010) intimated that flooding is a high-water stage in which water overflows its natural or artificial banks onto normally dry land, such as a river inundating its floodplain. Uncontrollable floods likely to cause extensive damage commonly result from excessive rainfall in a short period but may also result from ice jams during the Spring rise in rivers and from

Tsunamis. Flooding may also be described as a relatively high flow of water, which overflows the natural channel provided for runoff (Institute of Local Government Studies (ILGS) and International Water Management Institute (IWMI), 2012). In addition, when there is an overflow or accumulation of an expanse of water that submerges land then we can say there is flooding. All the various definitions have a common understanding that floods inundate the dry land and when this dry land is built, then lives and properties are affected. It should always be remembered that flooding is considered as a serious issue because of the damage to lives, property and infrastructure.

Floods occur due to the fast accumulation and release of runoff waters from upstream to downstream, which is caused by very heavy rainfall. Discharges quickly reach a maximum and diminish almost rapidly (Ouma & Tateishi, 2014). Floods also occur as a result of flow of a stream becoming so great that it exceeds the capacity of its channel and therefore overflows its banks (Cunningham & Cunningham, 2011). A flood simply can be described as water overflowing onto usually dry land. Flooding mostly is as a result of heavy rainfall; nevertheless, floods can occur in diverse ways that are indirectly related to current weather events. Therefore, a total explanation of flooding should embrace practices that may not directly be related to meteorological events (Doswell, 2007).

The consequences of floods, both negative and positive, vary greatly depending on their location, duration, depth and speed as well as the vulnerability and value of the affected natural and constructed environments (Tu Le, 2020). Floods impact both individuals and communities, and have social, economic, and environmental consequences. As Community links and

infrastructure such as power plants, roads and bridges are damaged and disrupted, some economic activities may come to a standstill, people are forced to leave their homes and normal life is disrupted (Ahamed & Bolten, 2017). Similarly, disruption to Industry can lead to loss of livelihoods. Damage to infrastructure also cause long-term impacts such as disruption for supplies of clean water, wastewater treatment, electricity, transport, communication, education and health care. Loss of livelihoods, reduction in purchasing power and loss of land value in the floodplains can leave communities economically vulnerable (Tu Le, 2020).

Floods can also traumatize victims and their families for long periods of time. The loss of loved ones has deep impact especially on children. Displacement from ones home, loss of property and disruption to business and social affairs can cause continuing stress. For some people the psychological impacts can be long lasting (Alderman, Turner & Tong, 2012). Standing flood waters can also spread infectious diseases and cause injuries. Each year, flooding causes more deaths than any other hazard related to thunderstorms. The most common flood deaths occur when a vehicle is driven into hazardous flood waters (Tu Le, 2020). Floods are the most common natural disaster in the United States. The worse floods in recorded history has been recorded in the People's Republic of China in 1931 which accounted for the death of close to 500,000 people. Moving flood waters just a few feet deep are capable of pushing cars and small trucks. Floods can either drown victims or kill them by carrying deadly debris. This is the result of many deaths that occurred during the 1976 flood that hit Big Thompson, Colorado (Alderman *et al*., 2012).

Some of the flood water collects in large, underground reservoirs, but most of it forms rivers and streams that flow into the oceans, bringing the water back to its starting point. Human activities that degrade the environment often increase flooding (Challa & Tilahun, 2014). These activities include deforestation. The lack of vegetation encourages water to flow over the surface rather than infiltrate into the soil thus increasing surface runoff. In many natural systems, floods play an essential role in maintaining key ecosystem functions and biodiversity by linking the river with the land surrounding it, recharge groundwater systems, fill wetlands, increase the connectivity between aquatic habitats and move both sediment and nutrients around the landscape, and into the marine environment. For many species, floods trigger breeding events, migration and dispersal. These natural systems are resilient to the effects of all but the largest floods (Arouri, Nguyen & Youssef, 2014). The environmental benefits of flooding can also help the economy through things such as increased fish production, recharge of groundwater resources, and maintenance of recreational environments (Alderman *et al*., 2012). Areas that have been highly modified by human activity tend to suffer more deleterious effects from flooding. Floods tend to further degrade already degraded systems. Removal of vegetation in and around rivers increase channel size, dams, levee bank and catchment clearing all work to degrade the hill-slopes, rivers and floodplains and increase the erosion and transfer of both sediment and nutrients (Dell, Jones & Olken, 2014).

While cycling of sediment and nutrients is essential to a healthy system, too much sediment and nutrient entering a waterway has negative impacts on downstream water quality. Other negative effects include loss of habitat,

dispersal of weed species. The release of pollutants, lower fish production, loss of wetlands function and loss of recreational areas (Challa & Tilahun, 2014; Thomas, Christiaensen, Toan, Le & Trung, 2010). Many of our coastal resources including fish and other marine production, are dependent on the nutrients supplied from the land during floods (Douglas, 2009). The negative effects of floodwaters on coastal marine environments are mainly due to the introduction of excess sediment and nutrients such as chemicals, heavy metals and debris. These can degrade aquatic habitats, lower water quality, reduce coastal life, and contaminate coastal food resources (Du, FitzGerald, Clark & Hou, 2010).

Some methods of flood control have been practiced since ancient times. These methods include planting vegetation to retain extra water, terracing hillsides to slow downhill and the construction of floodways (man-made channels to divert floodwater) (Hijioka & Lin, 2014). Some short-term responses to flooding is the provision of food aid by governments of affected countries and from other donor countries, provision of water purification tablets and the repair of embankment and help to rescue people. There is also the provision of free planting materials to affected homes and families (López-Marrero & Yarnal, 2010; Parvin, Shimi, Shaw & Biswas, 2016).

Floods claim approximately 20,000 lives and in one way or the other have adverse effects on at least 20 million people worldwide, especially the homeless (Smith, 2004). Flooding, after epidemics and transport accidents is considered one of the most common environmental disasters that occur all over the world. This is as a result of the geographical distribution of river floodplains and low-lying coasts and their long-standing attractions for human settlement (Smith, 2004). In disparity, flooding resulting from extreme hydro and

meteorological events and taking place in unexpected magnitudes and frequencies can cause loss of lives, livelihoods and infrastructure. They can also damage the environment (Integrated flood management tools series flood forecasting and early warning, 2013). In general, it was analyzed that worldwide flood is the most destructive natural hazards causing extensive damage to the built and natural environment, and devastation to human settlements. Economic losses due to the effects of damaging floods have increased significantly around the world (Integrated Flood Risk Management in Asia, 2005).

The frequency of natural disasters has been increasing over the years, resulting in loss of life, damage to property and destruction of the environment (Living with Risk, 2000). Flood losses reduce the assets of households, communities and societies through the destruction of standing crops, dwellings, infrastructure, machinery and buildings, apart from the tragic loss of life. In some cases, the effect of extreme flooding is dramatic, not only at the individual household level, but also in the country as a whole (Integrated Flood Management Concept Paper, 2009). The Fourth Assessment Report of the Inter-governmental Panel on Climate Change (IPCC) (2007) predicts "heavy precipitation events, which are very likely to increase in frequency, will augment flood risk". These floods affect life and livelihoods in human settlements in all areas, such as flood plains, coastal zones, river deltas and mountains. Flooding is also increasing in urban areas, causing severe problems for poor and vulnerable people. Considering the global picture of disaster, particularly in the flood event, the various rolling Vulnerability Assessments conducted in different countries indicate that the last two decades have seen an increase in the frequency and occurrence of climate-induced hazards such as floods and drought

(Concept Note on the Vulnerability Assessment and Analysis Survey for Zambia, 2006). According to Nott (2006), the causes of floods can be broadly divided into physical, such as climatologically forces, and human influences such as vegetation clearing and urban development.

**2.3 Flooding on Global Perspective**

Considering the global picture of disaster, particularly in the flood event, the various rolling Vulnerability Assessments conducted in different countries indicate that the last two decades have seen an increase in the frequency and occurrence of climate-induced hazards such as floods and drought in the countries (Concept Note on the Vulnerability Assessment and Analysis Survey for Zambia, 2006). According to Nott (2006), the causes of floods can be broadly divided into physical, such as climatologically forces, and human influences such as vegetation clearing and urban development. The most common causes of floods are climate related, most especially rainfall. Prolonged rainfall events are the most common cause of flooding worldwide. These events are usually associated with several days, weeks or months long of continuous rainfall. Human impacts on river catchments influence flood behaviour. Land use changes in particular have a direct impact on the magnitude and behaviour of floods all over the world. Deforestation results in increased run-off and often a decrease in channel capacity due to increased sedimentation rates.

Borrows and De Bruin (2006) indicated that among natural catastrophes, flooding has claimed more lives than any other single natural hazard. In the decade 1986 to 1995, flooding accounted for 31% of the global economic loss from natural catastrophes and 55% of the casualties. The damaging effects of flooding are likely to become more frequent, more prevalent and more serious

in the future. Carey (2005) argued that human populations worldwide are vulnerable to natural disasters. Certain conditions such as geographical location or people's income level can affect the degree to which natural disasters impact people's homes and livelihoods. A study by Nott (2006) correctly points out that a normal level of flood event is not considered to be a natural hazard unless there is a threat to human life or property. The most vulnerable landscapes for floods are low-lying parts of floodplains, low-lying coasts and deltas, small basins subject to flash floods. Rivers offer human respondents populations transport links, a water source, recreational amenities, fertile plains and are an attractive place for settlements. Floods then become a major natural hazard because of the high human population densities that inhabit these lands.

Nott (2006) indicated that the direct impacts of a flood are closely related to the extent of affected area and depth of floods water. The extent of a flood has a direct relationship with the recovery times of crops, pastures and the social and economic dislocation impact to populations of a country. Floods are the costliest and wide reaching of all-natural hazards. They are responsible for up to 50,000 deaths and adversely affect some 75 million people on average worldwide in every year. Disease occurrence is common especially in less developed countries. Malaria and Typhoid outbreaks after floods in tropical countries are also common. It has been estimated that in India and Bangladesh 300 million people live in areas that are affected by floods (Nott, 2006). Floods are among the most costly and damaging disasters posing a critical problem to city planners as they increase in frequency and severity. The frequency and severity of flooding has generally increased during the last decade (compared to 1950–1980 flood data), along with the frequency of floods that exceed levels that only

typically occur once every 100 years. Although there is variation in regional predictions, it is generally accepted that both trends will continue, especially in Asia, Africa and Latin America. Flood risk is also projected to increase throughout Europe, particularly in eastern and northern regions and along the Atlantic coast.

Assessments of vulnerability in Germany show that seaport cities Bremen and Hamburg may experience increased probabilities of flood risk from storms as climate change progresses, exposing billions of dollars of economic capital to potential damage (Sterr, 2008). The Netherlands is one of the most exposed countries in Europe, with nearly one third of the country located below average sea level in 2008 (VanKoningsveld *et al.*, 2008). Densely packed Amsterdam and Rotterdam are two out of ten cities that currently have the highest value of assets exposed to coastal flooding (Nicholls et al., 2008). A 2008 ranking of cities based on vulnerability to flooding found that the top ten cities in terms of exposed population were Mumbai (India), Guangzhou (China), Shanghai (China), Miami (US), Ho Chi Minh City (Viet Nam), Kolkata (India), Greater New York (US), Osaka-Kobe (Japan), Alexandria (Egypt) and New Orleans (US) (Nicholls et al, 2008). The study also predicts that by 2070 almost all cities in the top ten exposure risk category will be located in developing countries (particularly in China, India and Thailand) because of the rapid population growth occurring in these areas. On a national scale, the study predicts that the concentration of future exposure to sea-level rise and storm surges will be in the rapidly growing cities of developing countries in Asia, Africa and, to a lesser extent, Latin America. It is anticipated that the majority of high-exposure coastal land area (90 per cent) will be located in only eight

countries: China, US, India, Japan, The Netherlands, Thailand, Viet Nam and Bangladesh.

According to the Belgium-based Centre for Research on Epidemiology of Disasters (CRED), the world's most disastrous floods to have occurred in terms of the number of people who lost their lives happened in the year 2004 in Haiti, a Caribbean island nation (CRED, 2011). The report also indicated that for 14 days, there were continuous and heavy rains which caused swelling of rivers and subsequently overflowing of river banks mostly in the southeastern parts along the areas that share borders with the Dominican Republic. The continuous rain generated floods that killed over 2,400 people, the Guardian Newspaper reported (CRED, 2011). In Pakistan, the floods which destroyed at least 1,200 lives are already listed as the world's second worst flooding in the decade from 2001 to August 2010. "The number of people killed is very high for a natural event like a flood, which is among the easier disasters to predict and plan for," said CRED director Debarati Guha-Sapir.

### 2.3.1 Flooding in Ghana

Flooding in Ghana has become a yearly menace. Experts are grappling with ways and means of containing the floods in order to save lives and property. Over the past decade, floods have claimed several lives, and destroyed public infrastructure and property (Sam Jr, 2009). Ghana has been highly ranked amongst the African countries that is most exposed to risks from multiple weather-related hazards particularly natural hazards such as floods and droughts (UNDP/NADMO, 2009). Urban flooding has become a frequent occurrence in Ghana since 1930. At least 18 out of the last 50 years have recorded significant flooding incidences life in which lives and properties have been lost. Since 1995,

the frequency of flooding has increased in the coastal areas of Ghana. Flooding occurs often in urban areas in Ghana especially in Accra. Karley (2009) expounds that flooding problems in Accra date back to the late 1930s when the city started to expand. Flooding has become a perennial issue in Accra. During the rainy seasons each year, there are reports of flooding in many parts of the city. Studies by Hofmann et al., (1998) show a link between climate change and flooding. Nevertheless, the consequences of flooding in Accra are further exacerbated by human activities like building in flood-prone areas, encroachment on wetlands and poor enforcement of development control. There is also a lack of storm drains and waste disposal is done indiscriminately. Institutions that are responsible for flood control have also failed to manage floods.

In urban areas, the flood-damage potential is high, due to the concentration of property and people in relatively small areas and also haphazard ways of building. Urban flooding can simply be defined as a natural process in which drainage network systems overflow to their floodplains during rain storms. The causes of urban flooding in Ghana are generally diverse and to some great extent, highly interrelated (Sam Jr, 2009). Water from the Bagre Dam in Burkina Faso aids in irrigation of farms during the dry season and replenishes water levels in the Akosombo Dam when it drops to minimal levels. However, in 2007 severe rainfall caused the dam to overflow. Consequently, water from the dam was then released into the White Volta River which flow into Ghana at a force of 900 $m^3$ per second causing floods. This flood affected the whole nation and the northern regions in particular (Karley, 2009). The flood destroyed houses, water supply and drainage systems, collapsed bridges, schools, roads;

and also crops and livestock. Many families were displaced. The displaced families sought shelter in school buildings and churches (Forkuo, 2010). Furthermore, the floods added health implications, more especially the threat of the outbreak of epidemics. The National Disaster Management Organisation (NADMO) found it rather difficult to provide adequate food and other forms of aids for the flood victims (NADMO, 2007).

Other issues relating to floods in Ghana are the poor, ineffective and at times belated responses by the central government and other organizations (both governmental and non-governmental) in responding to the aftermath of floods (Okyere *et al*., 2012). For instance, between 2006 and 2012 the response by the main organization responsible for the management of natural disaster (National Disaster Management Organization (NADMO)) was reported by some sections of the media to be woefully inadequate and also ineffective. Several communities affected by floods in 2007 to 2012 were in need of relief items. These relief items supplied were not only reported to be insufficient but also arrived late. This led the interventions being either ineffective or late (Okyere *et al.*, 2012). The Ghanaian population has become increasingly urban over the past five decades. The percentage of urban population increased from 23.1 percent in 1960 to about 43.8 percent in 2000. This figure further increased to about 51 percent in 2010. The increasing urbanization presents some challenges in terms of provision of basic infrastructure in times of floods and other natural disasters and hazards (Okyere *et al.*, 2012). Therefore, urbanization has effect on national development agenda in terms of management of natural hazards and disasters and also provision of basic infrastructure to contain the effects of floods

in Accra and Ghana. The effects of flooding affect several parts of the country including the coastal, middle and northern areas (Okyere et al., 2012).

Since Accra is one of the fastest but not coordinated growing cities in West Africa (Yankson & Bertrand, 2012) it is also prone to frequent floods. From a political-economic point of view (especially from Marxist point of view) the urbanization processes which are prior to urban floods are of special interest. Since rapid urban growth is – although in many cases not planned and engineered from a centralized institution – not a product of coincidence, one has to ask about the major forces which produce, structure and fractionate the urban space. The fact of existing urban areas not provided with basic infrastructure (and thus not with adequate drainage- and canalization systems) is not just a result of poor urban planning but also related to a specific logic in market-driven societies (Okyere *et al*., 2012).

**Human-induced Activities and Flood**

Understanding causes of disasters has since evolved from explanations emphasizing natural causes to those linking causes to human actions that creates conditions that exposes people to hazards. Hitherto, disasters were equated with earthquakes, tornadoes, flooding and the likes (Cannon, 2011). This assertion created the impression that such disasters were caused by natural forces only with no link to the conditions that exposed people to such catastrophic events. According to Blaikie, Cannon, Davis & Wisner (2014) one approach in explaining causes of disaster was naturalist in which all blame is apportioned to the violent forces of nature. This explanation is problematic in the sense that it decouples the causes of disasters from anthropogenic factors and lays the blame solely on natural processes.

This natural hazard approach downplayed the role of humans in creating or contributing to all types of catastrophic events (O'keefe Westgate & Wisner, 2016; Hewitt, 2013). It also results in ineffective, incompetent and counter-productive solutions to disaster crises. This is because once the problem is wrongly diagnosed, the solution that will be prescribed will equally be wrong. Diagnosing causes of disasters and arriving at natural factors as the only cause will result in solutions that will only be geared towards containing those natural factors identified to the neglect of the human conditions that exposes them to disasters. Explanations have however, moved towards one that explores the societal construction of disasters (Bolin and Stanford, 2012; Cannon, 2011). Disasters are essentially social happenings, created by the interplay of natural and social factors and processes (Blaikie, Cannon, Davis & Wisner, 2010; Hewitt 2013). It is therefore difficult to decouple the natural and the social aspects of the causes of disasters as Blaikie *et al.* (2014) stressed that the natural and the social cannot be separated from each other. Disasters are a complex mix of natural hazards and human conditions that exposes people to harm. The natural and physical agents that cause floods for instance cannot be stopped. It is rather the social aspects such as building adequate drainage system, developing resistant buildings, quality and adequate source of livelihood, early warning signs, creating disaster awareness and preparation, that determine the extent to which a community or society is affected by floods.

According to McEntire (2011), disasters are as a result of the deadly and destructive outcome of triggering agents. Triggering agents are natural forces that causes a hazard and as Cannon (2008) asserts, disasters may be triggered by natural hazards (such as wind, storms, or heavy rains) as well as factors he calls

social (processes involving economic, political and social factors). These triggering agents are from natural forces such as wind, heavy rains, storms, but it is the conditions of humans that exposes them leading to a disaster. Therefore, dwelling too much on natural forces without recourse to social factors misses the point and has the tendency of shifting attention away from social factors that exposes people to the natural forces that are rather essential in tackling disaster situations. A better approach is focusing attention on both natural and social forces that exposes people to hazards leading to a disaster. Even though according to McEntire, (2011) this approach may downplay the power of nature and physical causal agents, it rather brings to the fore the impact of social factors that makes people vulnerable before a natural hazard hit communities and makes their situation worse. It explains how societies create the conditions that make people face hazards differently.

### 2.4 Impact of Urban Development on Flooding

Urbanization increases magnitude and the frequency of flood hazards. The rate of increase is determined by the percent of impervious cover (roads, roofs, etc.), so highly urbanized areas have floods that rise more quickly than in natural areas (Alderman *et al*., 2012). If a flood is wide enough, it can result in a loss of wildlife and biodiversity in the flooded region. This may reduce the level of biodiversity, habitat potential and food present in the ecosystem which has a long-term impact on impacts on surviving wildlife. The changes in land use associated with urban development affect flooding in many ways (Dell *et al*., 2014). Removing vegetation and soil, grading the soil surface, and constructing drainage networks increase runoff to streams from rainfall and snowmelt. However, a series of experts including local authorities have said that

these new developments often increase the flood risk to surrounding areas because water that would be otherwise absorbed by the land instead runs off more quickly into rivers that then burst their banks (Hijioka & Lin, 2014).

Key feature of cities is a high degree of imperviousness, as roads, buildings, parking lots and other paved areas occupy a main share of urban land areas. As a result, changes to impervious surfaces (IS) are often used as an indicator of urbanisation and urban development. The abundance and location of sealed surfaces is a key determinant of environmental quality, as it has important implications for many bio-physical processes, both regionally and locally (Weng, 2012). For major urban areas, these processes are primarily linked to the hydrological cycle and the surface energy budget (e.g. Urban Heat Islands). Thus, changes in the quantity and location of IS alter an area's hydrological response, since replacing natural land cover with artificial sealed surfaces reduces infiltration capacity, surface storage capacity and evapotranspiration (Parkinson & Mark, 2005; Butler, 2011; Hall et al., 2014). Moreover, it leads to increased run-off volumes, discharge rates, flood peaks and flood frequencies (Butler, 2004). For this reason, past and present city development patterns may prove to have (and will continue to have) important implications for the exposure of urban systems to pluvial flooding.

The detailed compositions of urban environments – as urban land-use is typically characterized by pronounced spatial and temporal dynamics – is a challenge in terms of mapping urban structure and development at the scale required for many applications, such as flood modelling, urban planning and risk assessments. Conversely, satellite imagery and remote-sensing techniques may provide complete temporal and spatial coverage of cities globally from the 1970s

onwards, thus facilitating accurate, systematic and resource-efficient approaches for the mapping of urban landscapes at various scales. As urban development is observed at annual or even decadal timescales (urban development rates differ considerably between regions), temporal. coverage is of great importance when selecting data for change analyses: while high-resolution satellite imagery only dates back to the late 1990s, medium- resolution data, including Landsat imagery, is available for the past thirty to forty years, allowing for extended time series of urban land cover. That said, most current satellite-based remote-sensing techniques for urban mapping are generally considered to be highly complex and resource-intensive (economic, data and software requirements are high), and are thus not yet readily available for many potential users, especially outside of the scientific community. In practice, this often restricts the use of such methods for a wide variety of applications, including urban flood modelling and analyses of the importance of urban development and structure in the contexts of climate change and extreme events.

Risk assessments of urban flooding require an integrated approach in which detailed information on extreme precipitation characteristics (e.g. from extreme value analysis of climate model projections), land cover, land use, human behaviour and economics are combined to provide decision-makers and other stakeholders with specific knowledge of the risks of the diverse array of assets that exist within urban environments. Integrated risk assessments are surrounded by large uncertainties originating from the different types of analysis involved and the complex linkages of different analytical tools, including climate models, physical impact models (e.g. flood models) and socioeconomic damage assessments. Altogether this plethora of uncertainties provides the basis

for a wide range of climate change risk estimates. Assuming that the level of risk defines the upper boundary of what society should be willing to spend on adaptation measures; this likewise implies a wide range of appropriate responses to climate change. Least Developed Countries (LDCs) are particularly vulnerable to climate change and to the adverse impacts of extremes due to their low incomes, weak infrastructure and limited institutional capacity for coping with climate change. Also limited data availability often hinders the application of detailed geographical information to climate projections, land cover and socioeconomics, including accurate damage costs.

Urbanization aggravates the damages caused by flooding by constraining where flood or storm water can pass. Odemerho, (2010) says that vast parts of the ground with roofs, roads and pavements are covered; impeding sections of natural channels and building drains that ensure that water moves to rivers faster than it did under natural conditions. This is shown in urban environments where the infiltration capacity is minimized by the replacement of ground cover with impervious urban surfaces Considering the increase in the number of urban dwellers globally, the number of people at risk or susceptible to flood hazards is likely to increase. Any increase in disasters, whether in small or large proportions may threaten development gains and hinder the implementation of the Millennium Development Goals (UN-ISDR, 2008). Disasters create serious challenges to the economy of a nation. It should be observed that the economic environment of a nation is constituted of its financial systems, social welfare, power sector, transportation, investments, commerce, manufacturing and construction as well as banking. The aftermath of disasters is pain and huge

losses to the economy and it is quite complex when quantifying the actual cost of damages and recovery.

**2.5 Effects/Impact of Floods**

Effects of flood generally refer to the several types of harm and dangers that come along as a result of flooding incidence. The effects of flooding are felt both immediately and later. The effects are numerous and in many cases are grave. Floods have many negative effects on lives, property, infrastructure and economy. Nevertheless, there are a few positive effects of floods. It deliberates on a vast range of harmful effects on humans, their physical and emotional well-being, their day to day activities, their health and properties, on public infrastructure and amenities, the environment, ecological systems, industrial production and the competitive strength of the affected economy (Stromberg, 2017). Floods are nature's way of managing excess water from precipitation as well as the hydrologic cycle. This helps to maintain a balance in the cycle. Also, when floods occur, much needed nutrients are deposited on the flood plains. The alluvium from such floods provides essential nutrients needed by plants to grow well. This indirectly helps in protecting water bodies since plants which grow on the flood plains help to check erosion and protect against silting. Also, crops cultivated in alluvial soils usually produce bumper harvests and thus provide communities in such areas with sufficient food.

Some alluvial deposits also contain precious minerals such as gold. In Ghana, alluvial deposits which contain gold can be found in streams or rivers that run over areas with Birimian rocks (Oppong, 2011). The gold which is finely divided can be found in riverbeds, riverbanks, dry valleys, gravel beds, beach gravels and sand. Although the mining of gold and other precious materials give

rise to environmental concerns worldwide, flood waters which leave these alluvium deposits on river banks provide many nations with foreign exchange when these minerals are exported. Flooding can however play a beneficial role in natural habitats. Many wetland habitats are dependent on annual flooding for their sustainability and can contribute to the storage of flood waters to reduce flood risk elsewhere. Freshwater floods especially play an important role in maintaining ecosystems in river corridors and are essential in maintaining floodplain biodiversity.

The impact and damages caused by flooding are almost impossible to quantify as there could be other developing effects in later years after its occurrence and some effects may take some years to notice. Flooding is natural phenomenon that is almost impossible to totally eradicate but, in most instances, the damaging effects are mostly as a result of human activities directly and indirectly and changes to the environment. Occurrence of floods can be a catalyst for other unforeseen hazards both natural and human induced, or can be a major part of a long-term chain of cascading events (ActionAid, 2006). A study by the International Flood Initiative (2003) suggests that floods are the most taxing of water related natural disasters to humans, material assets as well as to cultural and ecological resources affecting people and their livelihoods and claiming thousands of lives annually worldwide. According to a study experience, the emotional behaviour of many flood victims was shocking. Follow-up studies of the same experience found that the flood and the secondary effect of the flood have a serious emotional trauma. Factors that contributed to the non-recovery included the severity of the flooding, the degree of the resulting financial hardship, age and socio-economic status.

Poor people on low income houses are mostly flooded in maximum years (Flood Management in Australia, 1998). Thus, a severe flood can impose a range of economic costs on flood victims and many of them are quite severe. Moreover, the economic effects may linger for years after the event. Flood aware communities can be expected to suffer less social and financial disruption than communities with a low level of flood awareness (Flood Management in Australia, 2011). Lindsell & Prater (2003) argue that social impacts can cause significant problems for the long-term functioning of specific types of households and businesses in an affected community. A proper contingency plan is needed in order to readies the impact of the flood and to protect the livelihood.

Some of the most important direct consequences of flooding such as loss of human life or the consequent ill health of the survivors and also the economic losses are intangible. Indirect and intangible consequences of flooding are probably greatest in Least Developed Countries (LDCs), especially where frequent and devastating floods create special impacts for the survivors. Primarily losses of any disaster like flood can be high in rural areas where most of the damage is sustained by crops, livestock and the agriculture infrastructure, such as irrigation system, levees, walls and fences. In other words, primary losses relate mainly to the disruption of economic and social activities, especially in urban areas, immediately after a flood (Smith & Ward, 1998). According to Lind *et al.*, (2008), the loss in case of flooding has many dimensions. In addition to economic loss and loss of life and injury, there may be irreversible loss of land, of historical for cultural valuables and loss of nature or ecological valuables Kundzewicz *et al*., (2002) argues that floods are natural phenomenon for which the risks of occurrence are likely to continue to grow, increasing levels of

exposure and insufficient capacity among the factors responsible for the rising vulnerability. Water related events such as floods have been a major concern since the dawn of human civilization. They continue to hit every generation of human beings, bringing suffering and death as well as immense and still growing, material losses.

**2.6 Mitigation Measures at the Local and National Level**

Despite increasing mitigation efforts human vulnerability to flooding continues to increase (Aboagye, 2012). More than a decade after a major flood disaster, losses associated with successive floods continue to increase. For example, the floods of July 3, 1995 destroyed major roads, thousands of homes and took 13 lives in Accra but on June 28, 2001, flooding in Accra led to the death of 20 people, the displacement of thousands of households, and the destruction of millions of dollars' worth of property (The Daily Graphic, 2001). Between 1995 and 2007, more than ten incidents of flooding were recorded in Accra that resulted in the loss of human life, displacement of households, infrastructure damage, and disruption of economic activities with each successive flood having a severe impact than the previous one (Government of Ghana, 2001; 2003). One would expect that people who have long experience with flooding would develop methods to mitigate their impacts. Therefore, if flood victims continue to suffer heavy losses, then explanations should be pursued (Aboagye, 2012).

Maskrey (2009) rightly pointed out that, disaster management should not be treated as one single issue but should be incorporated into the socioeconomic activities of local people. Because community-based activities (and community-based organizations) are deeply rooted in the society and culture of an area, they

enable people to express their real needs and priorities, allowing problems to be defined correctly and responsive measures to be designed and implemented (Shaw, 2006). Given the devastating effects of flooding, it is important to develop appropriate measures to at least reduce the impact on human lives and economies. Ghana has a number of policies such as the National Water Policy, Sanitation Policy and the Blue Agenda, which were focused on reducing the effects of disasters, including flooding (Ministry of Environment, Science, Technology and Innovation, 2013). However, these policies, in addition to other locally enacted laws and regulations, have not been implemented effectively because of various socio-political factors (Ministry of Environment Science Technology and Innovation, 2013). Article 36 (9) of the constitution of Ghana states that: the State shall take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek cooperation with other states and bodies for purposes of protecting the wider environment for mankind. (Ministry of Environment, Science, Technology and Innovation 2013)

Here, the constitution clearly recognises the need to devise appropriate and urgent solutions to protect humanity and the environment (Danso & Addo. 2016; Graphic Online, 2014). These factors draw attention to the need to find durable solutions to the flooding incidents in the communities and beyond. Considering the case-peculiarity of communities close to the Anankwari, Kansawura and Whin rivers within the Secondi-Takoradi Metropolis for instance, a well-planned voluntary and permanent relocation of residents living along the river banks can be considered as a durable solution to the long-lasting effects of flooding which have existed in the metropolis as far back as 1971 (Daily Graphic, 2015). Continuous stay at the same location makes the victims

more vulnerable to future disasters (De Ville de Goyet, Marti & Osorio, 2006). Similar recommendations have been given by Oteng-Ababio, Owusu and Addo (2011), and Ahadzie and Proverbs (2011) in their respective studies of different localities lying close to river bodies. It is known that permanent relocation as a durable solution to flood disasters is more likely to be effective when the idea is willingly initiated or received by the people at risk as well as victims of flooding (Leighton, 2012). However, little is known about the sociocultural and economic factors that influence voluntary and permanent relocation of flood victims and populations at risk of flood disasters.

Some countries have embarked on large scale interventions to control flooding. In Bangladesh for instance, flooding has caused considerable damage to lives and properties. According to Thompson and Sultana (2016) Bangladesh is most likely, the world's most flood-prone country. This can be explained by the drainage pattern in the country whereby three rivers drain a vast area that is even greater than the area of Bangladesh itself. Over 20 percent of Bangladesh is inundated in a "normal" flood year and more severe floods regularly cause loss of lives and economic suffering. To reduce the effects of floods in communities, flood control projects need to be embarked on to save lives and properties. Thompson and Sultana (2016) explain that in Bangladesh, following severe floods in 1954, a Master Plan for water resource development identified flood control measures which were implemented. In June 1990, the Bangladesh Water Development Board (BWDB) reported the completion of 437 projects resulting in 7,555 kilometres of embankments and 7,907 hydraulic structures. Overall, 3.37 million hectares of land were reported to have benefited from flood protection (23 per cent of the area of Bangladesh). This was thought to be a

success till 1987 when it was reported that over 39 per cent of the country was flooded. The World Bank (2013) reported that about 1,279 kilometres of flood control embankments were damaged, and total losses were US$ 0.5 billion. Hence, the measures put in place were not effective in controlling the floods.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter presents a brief description of the study area. It also presents the methods used in the data collection, the sampling technique and the procedures used for the data analysis which constitutes the research methodology. Basically, this section is a presentation of how the research was conducted.

## 3.2 Study Area

The study was conducted at Maamobi in the Ayawaso North Municipality. The Ayawaso North Municipal is one of the 260 Metropolitan, Municipal and District Assemblies (MMDAs) in Ghana, and forms part of the 29 MMDAs in the Greater Accra Region. The Ayawaso North Municipal Assembly was curved out of the then Ayawaso East Sub Metro of the Accra Metropolitan Assembly as one of the 38 newly created and upgraded Municipal Assemblies in 2018 with LI 2310, the Ayawaso North Municipal Assembly has its capital as Newtown The municipality was inaugurated on March 15, 2018 alongside other 37 newly created Municipals/Districts

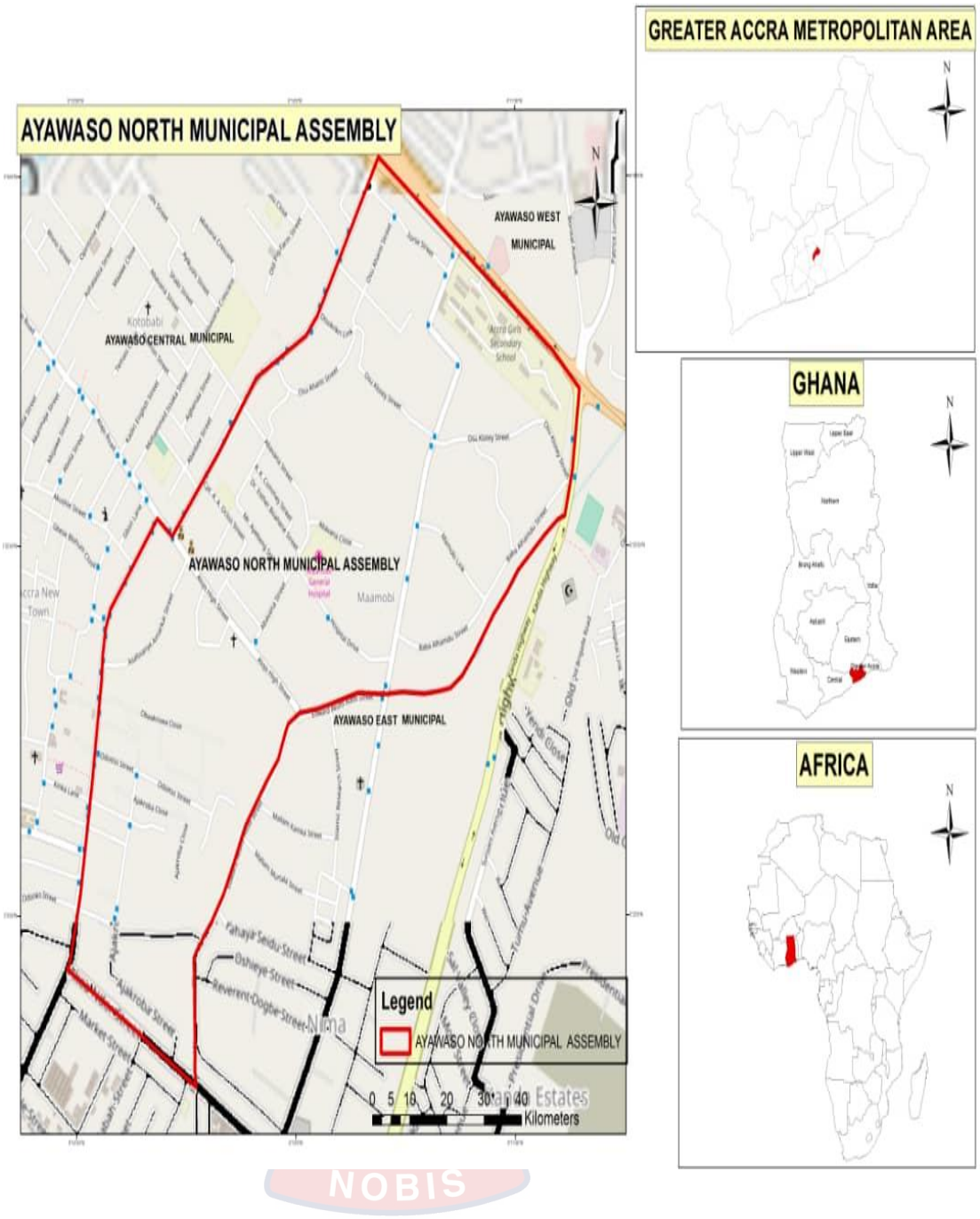




**Figure 1: Map of Ayawaso North Municipal Assembly**

Source: Ayawaso North Municipal Assembly (2010)

### 3.2.1 Population

The Municipal Assembly has a population size of 62,846as per the 2010 PHC, this population is estimated to be 76,879in 2018. Communities within these Electoral Areas are classified to be third class residential areas. The total

number of households is Fourteen Thousand, Seven Hundred and Seventy-five (14,775) and the total number of houses is Three Thousand, Four Hundred and Two (3,402) as per the 2010 census. The entire Municipality covers an area of 2.2km (Ayawaso North Municipal Assembly, 2019).

### 3.2.2 Boundaries

The Ayawaso North Municipal Assembly is bounded by Ayawaso West Municipal Assembly to the North and West, Ayawaso East Municipal Assembly to the South and Ayawaso Central Sub-Metroto the East. The boundary of the Municipality starts from Gold House round-about (Kawokudi) and follows the Obasanjo highway and turns left at Obasanjo round about at Pig Farm junction through the main Kotobabi road towards the Kotobabi police station then right on the Alajo road then an immediate left unto the Newtown road. The boundary line continues on the Newtown road and turns left before the Mallam Atta Market (near the Bank of Africa) ends at Nima storm drain bridge and follows the drain across the Nima main road and ends at Hilla Liman Highway (Ayawaso North Municipal Assembly, 2019).

### 3.2.3 Economy of the Municipality

The key sectors of the Municipal economy are industrial manufacturing and processing which constitutes about 25.5%, the service sector 71.82%, agriculture 2.68%. Majority of the people in the municipality are employed in the service sector in the area trading, artisanal works, public and civil servants. The minor industrial and manufacturing activities in the area of sachet water production, food processing, wood design. The agricultural activities mainly involve animal and pockets of vegetable farming. The limited farming activities stems from the peculiar location of the municipality which is in the heart of

Accra and is highly built up area. This municipality has limited land space which does not encourage industrial and farming activities. However, effort will be made to encourage urban farming on the small open spaces. Even though, the service sector constitutes the largest economic activities in the municipality, its contribution to the local gross domestic product is small due the informal nature of such business (Ayawaso North Municipal Assembly, 2019).

### 3.3 Research Design

According Bryman (2012), a research design provides a framework for the collection and analysis of data and there are five of such research designs namely: Experimental, Cross-sectional, Longitudinal, Case study and Comparative designs. In this study a case study design is used to find answers to the research questions by allowing respondents within case study setting to air their views. Also, the study was mainly a descriptive survey. The descriptive survey involved the collection of data from a defined population to describe the present condition of the population or phenomena using the variables under the survey (Dada, Agbana & Adetayo, 2010).

### 3.4 Target Population

Target population for the study included heads of household, Assembly members and some National Disaster and Management Organization (NADMO) officials of the Ayawaso North Municipal Assembly in the Greater Accra region of Ghana. Based on this, a minimum sample size of one hundred and twenty (120) respondents was derived.

### 3.5 Type and Sources of Data

The sources of data for this study were from both primary and secondary sources. The primary data was obtained from the field through various data

collection techniques, including questionnaire survey, interviews, and field observation.

### 3.6 Sample size

A sample size of one hundred and twenty (120) respondents was considered for the survey within the study area. This sample of 120 comprised 115 household heads, 4 NADMO Officials and the Assemblyman for the Study area.

### 3.7 Data Collection Instruments

In conducting this study, structured self-administered questionnaires were used to collect the relevant data. The questionnaires contained close-ended and open-ended questions which included socio demographic characteristics, knowledge of flooding and the possible causes of flooding in the area. In addition to this, observational checklist was used to collect data on flooding in the area.

### 3.8 Sampling Procedure

Random sampling and Purposive sampling techniques were employed to select respondents. The simple random sampling technique was applied to select the respondents for the study. In this technique, each member of the population had an equal chance of being selected as subject (Housden, 2010). The application of simple random sampling technique was made possible by the availability of detailed sampling frame from the NADMO office which has identified the units of inquiry by their names and location. This allowed the researcher the opportunity to engage respondents by approaching them in the market area and on the street and administering the questionnaires. With respect to the other respondents thus the NADMO officials of the Ayawaso North Municipal Assembly and the Assembly man of the study area, purposive

sampling technique was applied to select them. These respondents were purposively selected because they represent information-rich cases that would give insight to the study.

### 3.9 Data analysis

The data collected for the study were analyzed with the aid of Statistical Package for Social Sciences (SPSS) software version 16.0. According to Bryman (2012) qualitative data that is collected is first transcribed and coded taking theoretical ideas as well as the main themes of the study into perspective. This was what guided the analysis and so after collecting the data I transcribed the interviews and coded them. The transcription and coding were to organise and give meaning to the data. Therefore, SPSS was extensively utilized to analyze responses from respondents to give an account in the form of illustrated diagrams and tables for easy comprehension. Statistical tools such as bar graphs and pie charts were used in the analysis.

### 3.10 Ethical Issues and Clearance

One of the most critical issues of concern in research is the ethical considerations and how the researcher goes about it. This can be said to be the standards and principles that govern the conduct of research. Diener and Crandall (2011) discuss ethical issues and categorized them under four main areas. These areas include harm to participants, invasion of privacy, informed consent, and whether there is deception. Issues regarding harm to participants mean researchers need to be careful and ensure that their research does not inflict any harm on participants. According to Bryman (2012), the issue of harm to participants has to do with how researchers maintain the confidentiality of records. This means the identities and records of participants should be handled

with confidentiality. The findings should also not reveal the identities of the participants as this can be harmful to them. However, with this study, participants were made to understand that they had the right to participate voluntarily and could also withdraw from the study at any point they so wished. Again, notion of confidentiality and anonymity was discussed with participants prior to their participation in the research. Also, the study did not allow respondents to provide their names on the questionnaires making traceability impossible, thereby ensured confidentiality.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.1 Introduction

This chapter is a presentation of the results of the analyzed data based on the data gathered from the study area. It also discusses the findings obtained from the study by assigning reasons and implications of the results in relation to the information obtained.

## 4.2 Background of Respondents

### 4.2.1 Sex of Respondents

The study revealed that 78 of the respondents representing 52% were females while 72 of the respondents representing 48% were males. This indicates that majority of the respondents who participated in the study are females confirming the 2010 population and housing census by the Ghana Statistical report that women outnumber men in the country. This is shown in Table 1:

**Table 1: Sex of Respondents**

| Gender | Frequency | Percent |
|---|---|---|
| Females | 78 | 52 |
| Males | 72 | 48 |
| Total | 150 | 100 |

**Source: Field survey (2020)**

### 4.2.2 Age of Respondents

Table 2 illustrate that 96 of the respondents representing 64% were between the age range of 20-30 years, 38 of the respondents representing 26% were between the age range of 21-40 years while 16 of the respondents representing 10% were between the age range of 41-50 years with 50+ years

recording nothing. This indicates that majority of the respondents considered for the study are quite young and energetic.

**Table 2: Age of Respondents**

| Age range (years) | Frequency | Percent |
|---|---|---|
| Between 20-30 | 38 | 26 |
| Between 21-40 | 96 | 64 |
| Between 41-50 | 16 | 10 |
| 50+ | 0 | 0 |
| Total | 150 | 100 |

**Source: Field Survey (2020)**

### 4.2.3 Educational Background of Respondents

Education, as believed by most development agents is the bedrock of development of a community or nation. Thus, the level of education is important in influencing human vulnerability. According to the 2000 Population and Housing Census, 14.9 % of person aged 3 years or older in Accra are not literate in English and Ghanaian languages (Ghana Statistical Service 2000). It was revealed from the study that 112 of the respondents representing 74% had their education up to the Junior High School (JHS)/Senior High School (SHS) levels while 18 of the respondents also representing 12% had their education up to the Diploma level with 20 of the respondents representing 14% having Post graduate as their education background. This indicates that all respondents interviewed for the study have had education at various levels of the academic. Also, the literacy of the respondents was critical in understanding how they perceive flood and its attendant problems. This result is illustrated in Figure 2:

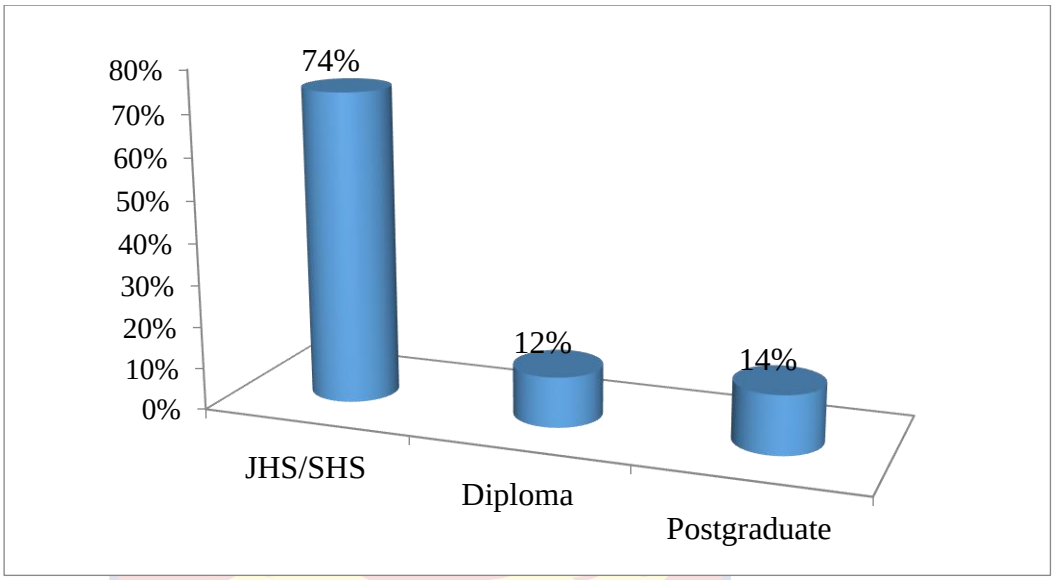


**Figure 2: Educational Background of Respondents**

**Source: Field survey (2020)**

### 4.2.4 Marital status of Respondents

Table 3 shows that 84 of the respondents representing 56% were married whiles 66 of the respondents representing 44% were single. This indicates that most of the respondents interviewed were married couples.

**Table 3: Marital Status of Respondents**

| Marital Status | Frequency | Percent |
|---|---|---|
| Married | 84 | 56 |
| Single | 66 | 44 |
| Total | 150 | 100 |

**Source: Field survey (2020)**

### 4.2.5 Occupation of Respondents

Table 4 shows that 116 of the respondents representing 78% were doing their own business, 16 of the respondents resenting 10% were working in the private sector while 12 of the respondents representing 8% were public servant workers with 6 of the respondents representing 4% being civil servants. This

boldly indicates that majority of the respondents were entrepreneurs for that matter have their own jobs. This is shown in Table 4.

**Table 4: Occupation of Respondents**

| Occupation | Frequency | Percent |
|---|---|---|
| Civil servant | 6 | 4 |
| Public servant | 12 | 8 |
| Private sector job | 16 | 10 |
| Own business | 116 | 77 |
| Total | 150 | 100 |

**Source: Field survey (2020)**

### 4.2.6 Duration of Stay in the Locality

Table 5 shows that 72 of the respondents representing 48% have lived in their locality for 11-20 years now, 38 of respondents representing 26% have lived in their locality for 1-10 years now, whiles 20 of respondents representing 14% have lived 21-30 years now in their locality with 20 of respondents also representing 12% have also lived in their locality for about 31+ years. This indicates that most of the respondents have lived in their locality for 11-20 years of which almost all are tenants.

**Table 5: Duration of Stay in the Locality**

| Years Lived in the Locality | Frequency | Percent |
|---|---|---|
| 1-10 | 38 | 26.0 |
| 11-20 | 72 | 48.0 |
| 21-30 | 22 | 14.0 |
| 31+ | 20 | 12.0 |
| Total | 150 | 100 |

**Source: Field survey (2020)**

### 4.3 Human-Induced Activities Contributing to Flood

Floods are the leading cause of natural disaster deaths worldwide and were responsible for 6.8 million deaths in the 20th century. The impact of flooding is driven by a combination of natural and human-made factors. When respondents were questioned about the human-induced activities contributing to flood, opinions were quite varied. Forty two percent (42%) believed it is poor urban development, 22% agreed that it is poor sanitation practice while 18% of the respondents also were of the opinion that it is due to deforestation and population increase respectively. This finding indicates that a number of anthropogenic activities within the urban areas of Accra have contributed to the flood increase not only in Maamobi but in Accra as a whole. The finding as shown in Figure 3 conforms to the finding of Rain, Engstrom, Ludlow & Antos (2011) that the massive growth of the city of Accra has caused impervious surfaces. Thus, as rain falls the discharge increases to cause overflow of the drainage channels. Rapid urbanization had caused drainage network to be under sized and unconnected to the river basins. In addition, a field inspection conducted revealed an extensive uncontrolled development occurring in risky areas which provide an impetus for flooding (Rain *et al*., 2011).

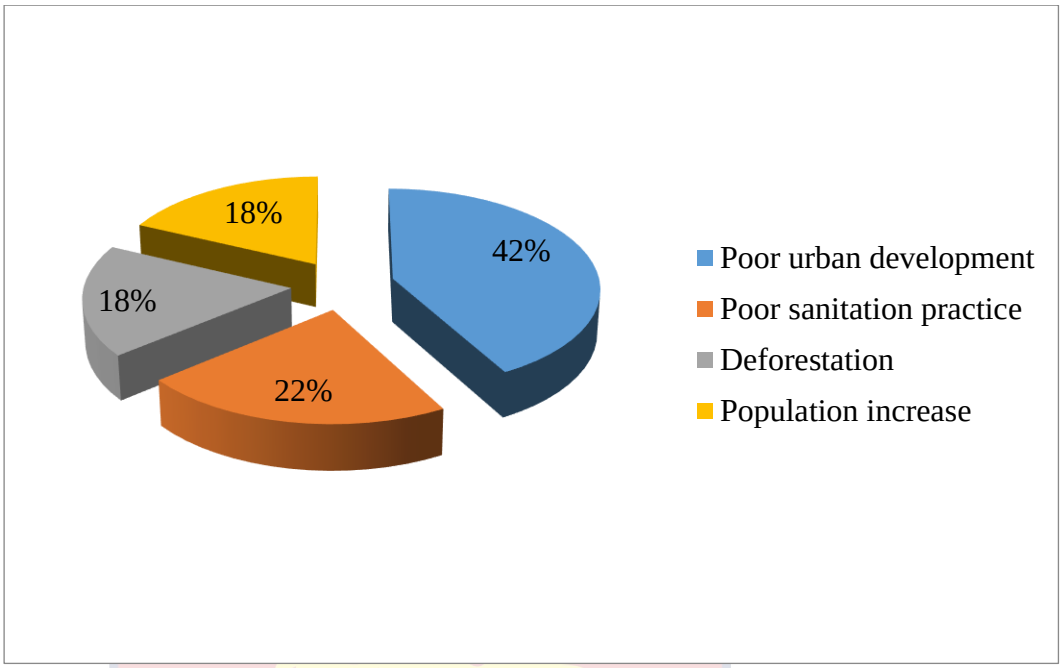


**Figure 3: Human-Induced Activities Contributing to Flood**

**Source: Field Survey (2020)**

### 4.3 Period of Experiencing Flood

When respondents were questioned on the period, they experience flood, 102 of the respondents representing 68% believe that they experience flooding whenever there is a heavy rainfall while 48 of the respondents representing 32% agreed that they experience flooding whenever there is prolong and heavy rainfall within the area. This result as shown in Figure 4 indicates that almost all of the respondents interviewed experience flooding whenever there is heavy rainfall which makes them vulnerable to many consequences of flood. This result conforms to an analysis by Karley (2013) that the rainfall time series data in Accra showed that the recent rainfall is not unusual and that could not explain the increased occurrences of flooding being experienced. Instead the causes of floods in Accra could be attributed to the lack of, drainage facilities to collect the storm water for safe disposal. One female respondent lamented: "Whenever I see the clouds gathering, my heart begins to beat like drum because last year I

lost lots of properties and never had a support from anyone.....” (Fati, 25th June 2020).

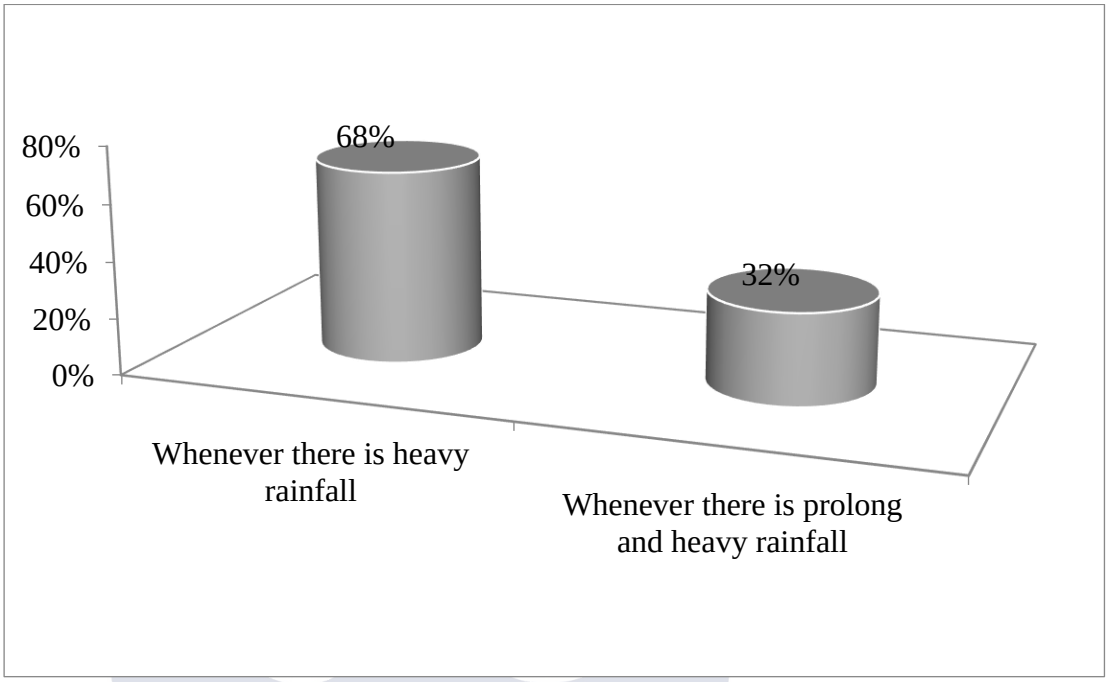


**Figure 4: Period of Experiencing Flood**

**Source: Field Survey (2020)**

### 4.4 Frequency of Flood Experience

It was revealed from the study that 54% of the respondents often times experience flooding between May and June of each year, 38% believe that they often experience flooding between July and August while 8% of the respondents gave no specific duration. This indicates that majority of the respondents witness an increase in flood during the rainy season which is mostly between May, June and July. This also confirms the weather forecast by the Ghana Meteorological Agency (GMA). A respondent upon further interrogation said “As for June and July, I don’t normally stay in this area, I leave here to go and stay with my sister in Nsawam because the flooding here is unpredictable” (Sulemana Yakubu, 25th June 2020). This is shown in Figure 5:

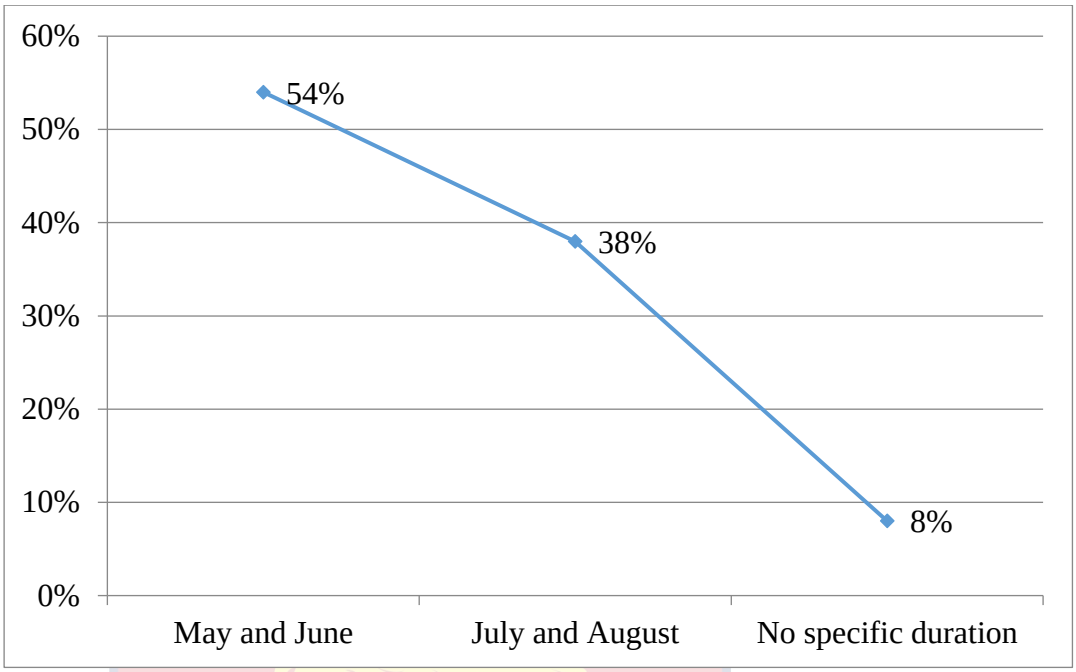


**Figure 5: Frequency of Flood Experience**

**Source: Field survey (2020)**

### 4.5 Knowledge of Respondents about Flood

Preventing flood damage through better understanding the public and experts' flood risk perceptions, as well as through information and knowledge sharing, are important elements of flood management. Empirical studies unambiguously indicate that knowledge influences risk perception. According to Birkholz, Muro, Jeffrey and Smith (2014), the perception of dangers and natural disaster is based on knowledge, which, in turn, is based on the previously gained information.

#### 4.5.1 Condition of Flood

When respondents were asked about the condition of flood, 62% of the respondents believe shallow running water is a flood condition, 26 of the respondents representing 18% also believe that deep running water is a flood condition, 12% of the respondents were of the opinion that stagnant but shallow collection of water is a flood condition while 8% of the respondents also were

of the opinion that deep and fast running water is a condition for flood to occur. That is the result shows that residents have knowledge about the condition which necessitate flood condition. Also, the result reveals that respondents have a divided opinion with regards to the flood condition thou majority agreed that shallow running water is a flood condition. A respondent named Shatu Musah shared her opinion upon further interrogation by saying:

"I have lived in this community for about 8 years now and very time it rains and I see the gutter full I begin to shiver....." (Shatu Musah, 25th June 2020). This is illustrated in Figure 6:

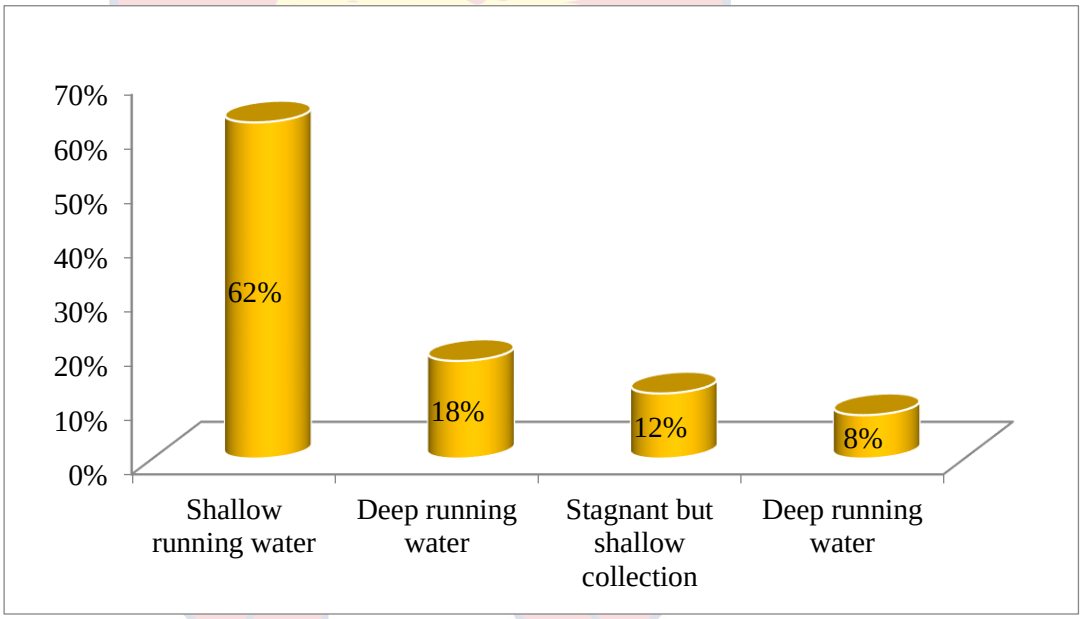


**Figure 6: Condition of Flood**

**Source: Field Survey (2020)**

### 4.5.2 Source of Flood

The study also sought to know respondent's knowledge and perception about the source of flood. It was revealed that 98 of the respondents representing 66% believe that the source of flood water within the community is runoff while 52 of the respondents representing 34% also believe that the overflow of a water body nearby is the source of flooding within the community. This indicates that

residents of Maamobi considered for the study and having lived in the area for long are much aware of the source of flood within the community. A respondent said: "You see, most of the flood waters are mostly from different communities because they lack bigger drains so it all descends down here" (Mr Yeboah, 25th June 2020). This is shown in Table 6.

**Table 6: Source of Flood**

| Source of Flood | Frequency | Percent |
|---|---|---|
| Overflow of a water body nearby | 52 | 34.0 |
| Runoff within the community | 98 | 66.0 |
| Total | 150 | 100 |

**Source: Field Survey (2020)**

### 4.6 Perception of Respondents About Flood

In recent years, perception of flood risks has become an important topic to policy makers concerned with risk management and safety issues. Knowledge of the public risk perception is considered a crucial aspect in modern flood risk management as it steers the development of effective and efficient flood mitigation strategies.

#### 4.6.1 Nature of Land

When respondents were asked to describe the nature of the land that necessitate flooding in the area, 40% of the respondents attributed the cause of flooding in the community to slight slope nature of the land while 38% believe the cause of flooding in the area is due to the deep slope of the land with 22% of the respondents also attributing the cause of flooding in the area to the flat nature of the land. This result reveals that the land nature of Maamobi community can also be attributed to the cause of flooding within the community. This contradicts

a study by Rain et al (2011) that the most important factor that influences the annual occurrences of floods in Accra is the massive growth of the city of Accra which has led to increased extent of impervious surfaces. Impervious surfaces are materials that prevent infiltration of water into the soils, and include roads, rooftops, sidewalks, bedrock outcrops and compacted soil. This is indicated in Figure 7:

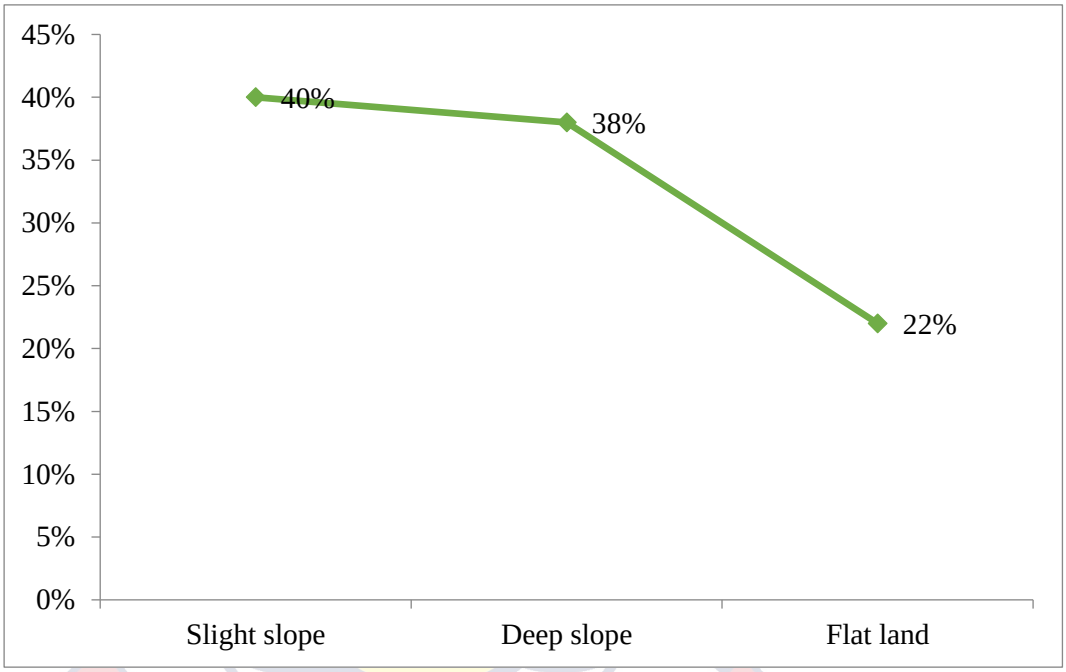


**Figure 7: Nature of Land**

**Source: Field Survey (2020)**

### 4.6.2 Possibility of Flooding

Due to the condition observed within the Community, respondents were asked about the possibility of flooding within the community. The study as shown in Figure 8 revealed that 58% of the respondents believe that the possibility of flooding in their community is really possible, 30% also believe that the possibility of flooding is slightly possible while 12% of the respondents also believe that flooding in the community is highly possible considering the improper erection of structures and the current weather condition. The finding

shows that respondents are much aware of the possibility of flooding considering the various factors within the community which can be categorised as both natural and manmade.

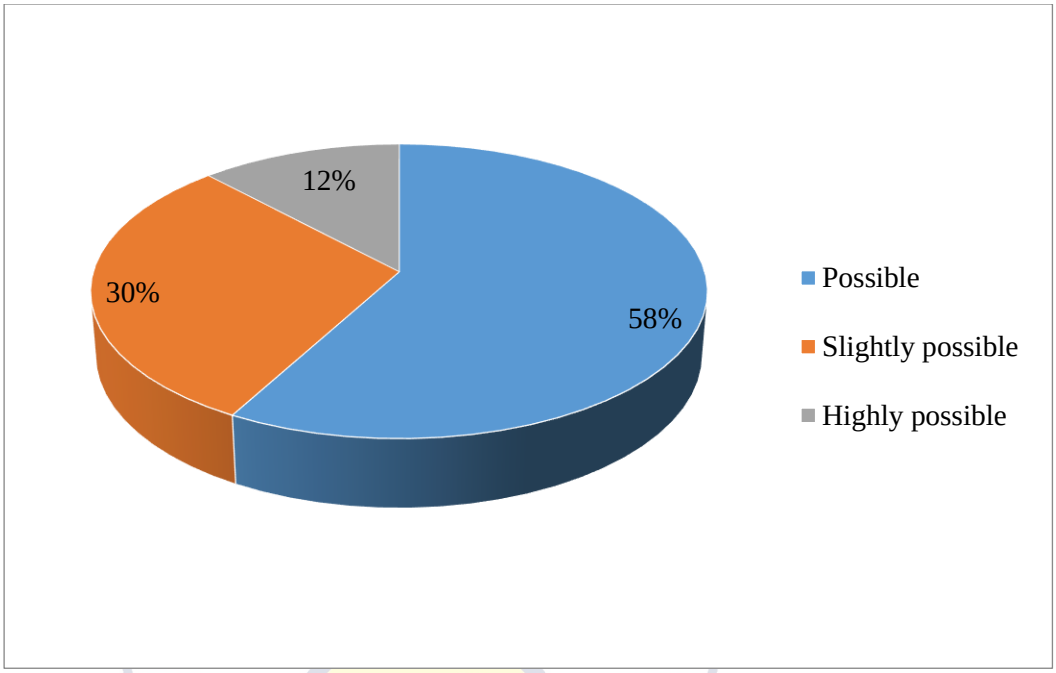


**Figure 8: Possibility of Flooding**

**Source: Field Survey (2020)**

### 4.7 Mitigation Measures to curb Flooding

It was observed during the study that due to the hazards caused by flooding, respondents put in place some measures in order to protect themselves against the impact of flooding. According to Djabatey (2011), many households in Accra mitigate all manner of problems associated with poverty by maximizing economic resources. Sixty two percent of the respondents when asked about the measures they have put in place agreed that they cemented the area to make the place better and also allow the free flow of rain water while 26% also suggested that gutters should be properly constructed to allow the free flow of rain water with 12% of the respondents who also suggested that relevant agencies who handle flood issues should be equipped with modern logistics to enable them

work effectively. This indicates that thou respondents put in some measures to protect themselves against the negative impact of flooding, respondents also suggested some measures to be considered by relevant agencies. This finding is similar to the finding of Aboagye (2012) which revealed that some households of Alajo rely on available social capital to mitigate the impact that flooding has on their households. Households also formed a group called social network. The essence of the social network is to provide financial and moral support, person-to-person contact for information regarding emergency management programs, and access to resources to mitigate hazards. This is indicated in Figure 9:

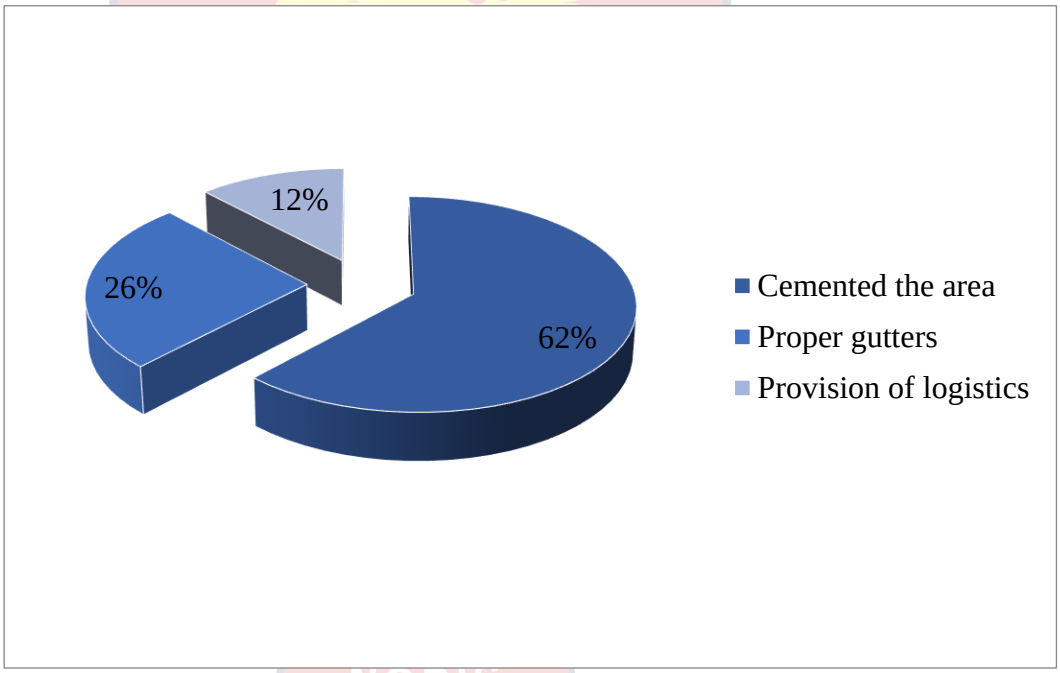


**Figure 9: Mitigation Measures to Curb Flooding**

**Source: Field Survey (2020)**

# CHAPTER FIVE

# SUMMARY, CONCLUSION AND RECOMMENDATION

## 5.1 Introduction

This chapter deals with the summary, conclusion and recommendations of the study. The chapter provides information on the summary of the findings of the project work, conclusion and also recommendations for further studies and policy making.

## 5.2 Summary

The study assessed the impact of flooding and its overall effects on the quality of life of residents of Maamobi in the Ayawaso East Municipality of the Greater Accra region of Ghana. The survey revealed that 52% of the respondents are females and majority of the respondents have had education at various levels with Junior High School (JHS)/Senior High School (SHS) being the highest representing 74%. It was revealed from the study that 48% of the respondents have lived within the Maamobi community for 11-20 years now. 68% of the respondents believe that they experience flooding whenever there is a heavy rainfall within the community. Almost all respondents believed that human-induced activities also contribute to the flood situation in the area as 42% were of the opinion that flood situation in most urban areas is due to poor urban development. It was revealed from the study that 54% of the respondents often times experience flooding between May and June of each year. With regards to the knowledge and perception of respondents about flood, 62% of the respondents believe shallow running water is a flood condition and 66% of the respondents believe that the source of flood water within the community is

runoff. However, 62% of the respondents believe that cementing the community is the best way of mitigating flooding within the community.

### 5.3 Conclusion

The study was undertaken to assess the impact of flooding and its overall effects on the quality of life of residents of Maamobi. Findings from this study showed that households living in flood-prone areas including Maamobi view flooding as one of the major problems they face. It's concluded that the aside from the natural causes of flood, respondents believe that human-induced activities equally contribute to flooding with poor urban development as the main human-induced activity. It can also be concluded that knowledge of respondents about flood is quite high as majority had knowledge about the months which they mostly experience flood which is between May and June of each year. Knowledge and perception of residents about flood is key in solving flooding related activities within the community. It can therefore, be concluded that the perception risk of residents of Maamobi with regards to flooding are quite high making them to adapt strategies to mitigate flooding disaster. Cementation of the community to allow the free flow of water was the main mitigation strategy residents adapted to curb the flooding disaster of the community.

### 5.4 Recommendations

Based on the key findings of the study, the following recommendations are made:

1. Government should mainstream flood risk management into wider development plan. This can afford local government not to ignore risks,

particularly those related to flood, climate change, urbanization and environmental degradation.

2. Government through the Municipal Assembly should adequately provide for drainage systems and scope for land use management to increase surface water management capacity. This will ensure that buildings or infrastructure are not constructed in a way, or in locations, that actually further deteriorate the problems.

3. The Ministry of Interior through the Municipal Assembly should ensure systematic mechanisms for collecting and managing information related to the changing nature of flood risk. This will increase the knowledge level of residents about when to experience flood.

4. There is a need for suitable institutional arrangement and policy framework to encourage integrated flood risk management systems. This will ensure that the mismatch between the governance of official disaster management mechanisms and what is actually needed for implementing integrated flood risk management, is not a major barrier to implementation of flood risk management.

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# APPENDIX

## QUESTIONNAIRE

## PRESBYTERIAN UNIVERSITY COLLEGE, GHANA

## FACULTY OF DEVELOPMENT STUDIES

## DEPARTMENT OF ENVIRONMENTAL AND NATURAL RESOURCES MANAGEMENT

Dear Respondent,

I am a graduate student from the Presbyterian University College, Ghana undertaking a research into flooding and its overall effect on quality of life of the residents of Maamobi leading to the award of an MSc in Sanitation Management. This questionnaire is designed to solicit your views meant to support it in academic research and your confidentiality is highly guaranteed.

**Part One**

**Section 1:** Demographic data

Tick (√) the following boxes and fill where applicable

1. Gender: a. Male [ ] b. Female [ ]

2. Marital Status: a. Married [ ] b. Single [ ] c. Divorced [ ] d. Separated [ ]

3. Occupation: a. Civil Servant [ ] b. Public Servant [ ] c. Private Sector Job [ ] d. Own Business (Job) [ ]

4. Age: a. Between 20 – 30 [ ] b. Between 31 – 40 [ ] c. Between 41 – 50 [ ] d. Between 51 – 60 [ ] e. 60+ [ ]

5. Education Background: a. JHS – SHS [ ] b. Diploma [ ] c. First Degree [ ] e. Post Graduate [ ]

**Part Two**

**Section 1: This is aimed at soliciting respondent's views on the topography and possible cause of flooding in the locality**

6. How many years have you lived in your locality? a.1 – 10 years [ ] b.11 – 20 years [ ] c. 21 – 30 years [ ] d. 31 + [ ]

7. What is your current residential status? a. House Owner [ ] b. Tenant [ ] c. Land Owner [ ] d. Others (specify)……

8. (i) What building material is your house/shelter made of? a. Clay Mud/Atakpame [ ]

b. Brick [ ] c. Cement block [ ] d. Plywood [ ]

(ii) Did part of your house cave in or collapse due to the floods? a. Yes [ ] b. No [ ]

9. (i) Has your community ever experienced flooding before? a. Yes [ ] b. No [ ]

(ii). How often do you experience flooding in your locality? a. Whenever there is prolonged and heavy rainfall [ ] b. Whenever there is heavy rainfall [ ] c. Whenever there is a slight rainfall [ ]

10. When do you often experience flooding? a. Between March and April [ ] b. Between May and June [ ] c. Between July and August [ ] d. No specify duration (intermittent) [ ]

11. (i) Do you believe human-induced activities contribute to flood? a. Yes [ ] b. No [ ]

(ii) What are these human-induced activities? a. Poor urban development [ ] b. population increase [ ] c. Poor sanitation practice [ ] d. Deforestation [ ]

12. What is the nature of the land in your locality? a. Deep slope [ ] b. Slight slope [ ]

c. Flat land [ ] d. Valley [ ]

13. What is the nature of water drainage in your community? a. Through storm drains [ ]

b. Through gutters [ ] c. Through crevices [ ] d. By natural means [ ]

14. Can you tell the speed of storm water in you location? a. Very High Speed [ ]

b. High speed [ ] c. Moderate speed [ ] d. No speed at all [ ]

15. What is the possibility of flooding in your neighborhood? a. Highly Possible [ ]

b. Slightly possible [ ] c. Possible [ ] d. Impossible [ ]

16. Where is the source of flood water to your locality? a. Overflow of a water body nearby [ ] b. Runoff within the community [ ] c. Runoff from neighbouring communities [ ]

d. Underground springs [ ]

17. To the best of our knowledge, what is the condition of flood water in your locality? a. Deep running water [ ] b. Shallow running water [ ] c. Stagnant but deep collections [ ]

d. Stagnant but shallow collection [ ] e. Deep and fast running water [ ]

18. Do your neighbors experience flooding too? a. Yes [ ] b. No [ ]

19. What type of human activity do you think can help aggravate flooding in your community?

a. Agricultural Activities [ ] b. Mining [ ] c. Waste Disposal [ ] d. Walking, roads [ ]

e. Others, please specify [ ]

20. Are there storm drains in your locality? a. Yes [ ] b. No [ ]

21. Do you have sufficient drains to carry excess runoff in your locality? a. Yes [ ] b. No [ ]

22. Are there drains (if any) open or covered? a. Covered [ ] b. Opened [ ] c. Partly Closed [ ]

**Section 2: This section aims at soliciting views on the contribution of waste disposal and management towards flooding**

23. Are there enough and appropriate dustbins in public places in your locality?

a. Yes [ ]

b. No [ ]

24. Does your households have dustbins? a. Yes [ ] b. No [ ]

25. Does your dustbin have a fitting cover? a. Yes [ ] b. No [ ]

26. How often do you dispose of your waste? a. Daily [ ] b. Weekly [ ] c. Monthly [ ]

d. Sometimes e. Never [ ]

27. In your estimation how many household use one dustbin? a. Only 1 [ ] b. Between 2-5 [ ] c. Between 6-10 [ ] d. Between 11-20 [ ] e. 20+ [ ]

28. How do the majority of the population in your community dispose off their waste?

a. Indiscriminately [ ] b. Waste bins [ ] c. Refuse damps in community

d. On water ways [ ]

29. Do you have any suggestions you believe will help curb flooding in your locality? Kindly share, please……

……

30. Do people lose lives and properties during flooding? a. Yes, only lives [ ] b. Yes, only properties [ ] c. No loss of lives and properties [ ]

31. Is there a recorded case (s) of flood disaster in your locality? Kindly name them. ((if any)

Thank you for agreeing to participate in filling this questionnaire. If you have any questions or queries, please contact Mariama Braimah on 0244098820 or mariamabraimah04@gmail.com

But finally, do you have any additional comments or suggestions relating to flooding in your locality?