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UNIVERSITY OF GHANA

COLLEGE OF HUMANITIES

ADAPTATION AND MITIGATION STRATEGIES TO PERENNIAL URBAN FLOODING: A CASE STUDY OF FLOOD-PRONE COMMUNITIES IN LA DADE-KOTOPON MUNICIPALITY

BY

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DECLARATION

I, **SETH MOKWAH**, hereby declare that except for reference to other people's work which have been duly acknowledged, this dissertation is the result of my own research carried out at the Institute of Statistical, Social and Economic Research (ISSER), University of Ghana under the supervision of DR. SIMON BAWAKYILLENUO

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ABSTRACT

Flooding has been a major problem over the years for cities of most developing countries across the world. In Ghana, the major cities especially Accra are noted for the prevalent occurrence of flood and its related menace. Like other districts in Accra, La Dade-Kotopon Municipality has not been spared by the phenomenon in recent times. Year by year, the municipality is hit by various degrees of floods resulting in loss of lives and destruction of hard-earned properties. Though the phenomenon is witnessed by the entire municipality, it is most prevalent in some identified communities within the municipality. This study therefore sought to look at the adaptation and mitigation measures adopted by various stakeholders to address the flood disaster phenomenon in the flood-prone communities within the La Dade-Kotopon Municipality.

To analyze the problem, five flood-prone communities were randomly selected for the study and out of this a total of 191 households were sampled to participate in the study. Primarily, the mixed methods research approach was adopted; and on that basis quantitative data was gathered through face to face household survey using structured questionnaires which was supported by qualitative data gathered through key informant interviews of key officials of the municipalities; in-depth interviews of the Assemblymen and some community members from the study communities and through direct field observations. Findings of the study show that, flood events in the study communities are primarily caused by some anthropogenic factors such as lack of drains; building on waterways; defective drainage design; choked drains; congested settlements; poor solid waste disposal practices among others even though they can also be attributed to some natural factors such as impervious nature of soil, low lying nature of the land and heavy downpour. It was also found that floods have posed several negative effects on the households in the study communities including loss of lives; physical injury to people; destruction of buildings

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and valuable properties; destruction of households' livelihood activities; pollution of the environment; erosion; disruption in the provision of utility services among others. The findings of the study also show that households employ several adaptation measures before, during and after floods to enhance their adaptive capacities. These include using sand bag to block water; digging flood diversion trenches; fixing pipelines to drain water out of the building; packing valuable properties on top of tables and wardrobes; leaving the building temporary to stay with neighbours; drying affected items; cleaning the rooms and compound after floods; mending roof of the building and repairing damaged items. Similarly community members collectively support adaptation by helping in evacuation of flood victims; providing temporal accommodation to some affected members; engaging in general cleaning and clearing choked gutters. The Municipal authority through NADMO also aid in adaptation by providing relief items to flood victims and providing emergency evacuation services to victims of flood. On mitigation however, the findings show that, it is predominantly done by households which are usually insufficient; on some occasions the community members also mitigate floods collectively through clean-up exercises, flood awareness campaigns, clearing choked gutters among others. Government institutions however have not really done much to mitigate the future occurrence of floods in the study communities. Also, it is established that households and other stakeholders are faced with some challenges in their efforts to adapt and mitigate floods: these include lack of funds; lack of cooperation among community members and stakeholders and reckless behavior of some community members among others. The study recommends that stakeholders, especially government should be very proactive in providing lasting solution to floods menace through the provision of storm drains; improved flood awareness campaigns, improvement in solid waste collection and management and through effective enforcement of building regulations.

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DEDICATION

I dedicate this work to my lovely wife, Mrs Juliana Mokwah, my kids, Prisca Annan and Arnold Benjamin Kobena Mokwah and to all my friends, especially Mina, Mavis, Joshua and Dada Incoom.

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LIST OF ABBREVIATIONS

EWS	Early Warning System
FEMA	Federal Emergency Management Agency
GFDRR	Global Facility for Disaster Reduction and Recovery
GSS	Ghana Statistical Service
HOD	Head of Department
HSD	Hydrological Service Department
IFM	Integrated Flood Management
IUFRM	Integrated Urban Flood Risk Management
LADMA	La Dade-Kotopon Municipal Assembly
MSD	Meteorological Service Department
MTDP	Medium Term Development Plan
NADMO	National Disaster Management Organization
NWSO	National Weather Service Organization
OPW	Office of Public Works
PHC	Population and Housing Census
TCPD	Town and Country Planning Department
UNDSEA	United Nation's Department of Social and Economic Affairs
UNISDS	United Nations' International Strategy for Disaster Prevention
USEPA	United States' Environmental Protection Agency
WDSC	Works and Disaster Sub-Committee
WHO	World Health Organization
WMO	World Meteorological Organization

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The occurrence of natural disasters globally has been very frequent in recent times, resulting in loss of lives, damage of hard-earned properties and destruction of the environment. Over the past two decades, the number of people who are exposed to the risk of natural disasters increase year after year, of which majority hail from developing countries with high poverty levels which makes them more vulnerable (UNISDR, 2004). Between 2000 and 2016 for example, an estimated global average of 100,000 people were killed each year through natural disasters, about 246 million people were affected by natural disasters and an estimated economic loss of US$880.88 billion was incurred over the same period (Guha-Sapir, Below, & Hoyois, 2016).

A greater percentage of the people affected by these natural disasters are resident in urban centres (ActionAid International, 2006). The current trend of increasing concentration of people in urban centres means that a lot more people will be exposed to various forms of natural disasters in the near future, hence the need for radical attention and planning. The United Nations' Department of Social and Economic Affairs (UNDSEA) (2016) for example, estimated that, about 54.5% of the world population resided in the urban areas as at 2016, and this is expected to increase to 60% by 2030. Again, the population of people who live in cities with at least one million inhabitants is expected to increase from 23% of the world's population in 2016 to 27% by 2030; whereas on the contrary the population of people living in rural communities is expected to decrease by 2030 (UNDSEA, 2016).

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The UNDSEA (2016) further argues that majority of people dwelling in cities, live in cities that have high risk of disaster related mortality or economic losses. Globally, an estimated 82% of cities as at 2014 were located in areas that faced high risk of natural disaster induced mortality. Similarly, 89% of cities, home to equivalently 2.1 billion people as at 2014, were located in areas that were highly vulnerable to economic losses induced by natural disasters (ibid). On average, cities in the less developed regions were found to be at higher risk of exposure to natural disasters and were more vulnerable to disaster-induced economic losses and mortality than cities in more developed regions. Moreover, larger cities were found to be at higher risk of exposure to disasters and more vulnerable to disaster-induced economic losses and mortality than smaller towns (UNDSEA, 2016). The phenomenon of interest to this study is the the fact that the fastest growing cities identified in recent times are located in less developed regions in Africa and Asia, most of which are more vulnerable due to their higher levels of poverty coupled with their relatively less capacities to withstand or recover from the impact of disaster events as compared to cities in developed regions.

Considering all natural disasters, floods are by far the most disastrous, frequent and widely spread throughout the world (Changnon, Schicht, & Semonin, 1983; Dhar & Nandargi, 2003; UNDSEA, 2016). Askew (1997) posits that floods account for about one-third of all deaths, one-third of all injuries and one-third of all damages caused by natural disasters. Though floods are seen as natural phenomena (Tempels, 2010), certain human activities also contribute to the problem. Hualou (2011) for example explains that flood disasters result from 'anthropogenic vulnerability' which is a consequence of the human interaction with the natural environment through activities like "designing and locating infrastructure, exploiting natural resources and concentration of population". ActionAid International (2006), also reveals that urbanization

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worsens flood situation by restricting where flood waters can go; by covering large parts of the ground with roofs, roads and pavements; by obstructing sections of natural channels and by building drains that ensure that water moves to rivers faster than it did under natural conditions. As more and more people are crowed in the cities, the effects of floods also intensify. As a result, even quite moderate storms produce high volumes and quick velocity of water in rivers and other water channels because there are more hard surfaces and drains. Citing Lagos in Nigeria, Free Town in Sierra Leone, Nairobi in Kenya, Kampala in Uganda, and Maputo in Mozambique as examples, ActionAid International (2006) asserts that flood induced disasters are the most popular natural disaster that affect lot of cities in Africa.

Over the years, large cities in Ghana especially Accra have also been noted for experiencing various magnitudes of floods. Karley (2009) for example argues that, the flooding problem in Accra can be traced as far back as the 1930s when the city began to sprawl. Since then and especially in recent times, flood has become a perennial albatross in the capital city. Year after year, especially during the raining season, reports of floods in many parts of the city dominate the airwaves. Primarily, flooding is considered as a natural phenomenon induced by climate change variability. Hofmann *et al*, (1998) for example argued that, there is a direct correlation between climate change and floods. This notwithstanding, the rate of occurrence and the effects of floods in Accra are further worsened by anthropogenic activities such as building permanent structures in areas susceptible to flood, encroachment on wetlands and poor enforcement of building regulations to control urban development (ActionAid International, 2006).

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1.2 Problem Statement

La Dade-Kotopon Municipal Assembly is one the sixteen district assemblies in the Greater Accra Region of Ghana. Located in the national capital, Accra, the municipality is perhaps one of the most privileged districts in Ghana. It hosts some land-mark state facilities including the Kotoka International Airport, Trade Fair, La General Hospital and Burma Camp Military Barracks as well as some popular business centres such as Accra Mall and Marina Mall. It also serves as host to number of Embassies and consulates such as the American Embassy, Australian Embassy, Chinese Embassy and Japanese Embassy; hence attracting host of local and international dignitaries at all times (LADMA, 2016). These expose the municipality to enormous opportunities which can guarantee its rapid economic development.

This notwithstanding, the municipality is faced with a league of environmental challenges making it vulnerable to a host of disasters. In an Interaction with key officials of the assembly during MA Development Studies Development Training Practicals[1], the Municipal NADMO Coordinating Director indicated that, floods is one of the most destructive disasters confronting the Municipality in recent times[2]. He indicated that over the decade, a number of communities in municipality have witnessed various degrees of flood disasters, the worse of which occurred on 3rd June, 2015 and 10th June 2016. Citing the Kodzor Stream for example, he explained that, following a heavy and prolonged downpour that occurred on 10th June 2016, the river exceeded its banks and entered into houses located as far as five hundred meters away from its channel displacing residents and destroying their properties. This is fundamentally blamed on the recent

[1] This is a course that gives opportunity to MA Development Studies Students from University of Ghana to interact with workers and departments of selected district assemblies once every week to give them exposure on how the local assembly system works in Ghana, and also to understand the developmental potentials and challenges peculiar to local assemblies.

[2] This was revealed on 06/10/2016 during Development Training Practical interactions between MA Development Studies Students from University of Ghana and LADMA NADMO Coordinating Unit.

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changes in climate patterns which results in long periods of drought and short periods of heavy downpour in recent times and consequently generating high volumes of running water that overwhelm the capacity of the existing drainage facilities in the municipality (LADMA, 2014). The phenomenon is further worsened by some anthropogenic and geographical factors that increase the vulnerability of residents in the municipality. These include building on water ways, choking of drainage channels due to poor waste disposal and management practices, impermeable land surfaces due to land use changes among others (ibid).

The National Disaster Management Organization (NADMO) is mandated to take leading role in the prevention and management of disaster in Ghana. With units at all regional and district levels, the NADMO coordinating unit at LADMA conducts routine checks; does education and sensitization tours, prepares situational reports on disaster cases and provides rescue and relief services to victims of disasters including flood victims in the municipality. These notwithstanding, floods still remains one of the most frequently occurring natural disasters in the municipality, leaving lasting gloomy memory in the minds of its victims (LADMA, 2014). The lives lost, property destroyed and the stagnations associated with floods leave one to wonder if stakeholders have been proactive enough in addressing the situation. In a memorandum prepared by NADMO Coordinating Directorate of LADMA, about ten communities are identified as the most vulnerable to floods in the municipality. These include Fisheries, Adzeman, Kenan Factory, Krakramu, Tse-Addo (communities along the Korjor River), Pentecost Down, El-Ymesh, Nyantrabishie, Nii Kwakranya Crescent and New Life Preparatory School. These communities experience floods of various degrees at any moderate rainfall (Municipal NADMO Directorate-LADMA, 2017). Data received from the municipal NADMO coordinating directorate revealed that, in 2016 alone as many as 31 flood incidences were recorded concurrently in some identified

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flood prone communities in the municipality following downpours on 23rd May, 10th June, 15th July, 3rd August, and 9th October. This was not quite different from the situation in 2014 and 2015 where 29 and 32 flood cases were recorded respectively (Municipal NADMO Directorate-LADMA, 2017)

This study therefore seeks to explore the adaptation and mitigation strategies adopted by various stakeholders to address the incidence of floods in the flood-prone communities in La Dade-Kotopon municipality. It further seeks to explore the effectiveness of these strategies and the constraints confronting stakeholders in implementing the adaptation and mitigation strategies in the municipality.

1.3 Aims and Objectives

The main aim of this research is to assess the various adaptation and mitigation strategies to perennial urban flooding in La Dad- Kotopon Municipality.

The specific objectives are:

1. To examine the causes of floods in the flood-prone communities in La Dade-Kotopon Municipality.
2. To assess the effect of floods in flood-prone communities in La Dade-Kotopon Municipality.
3. To assess the adaptation and mitigation measures put in place by households and other institutions in LaDMA to address flood disaster.
4. To assess the constraints in the implementation of adaptation and mitigation measures.

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1.4 Research Questions

The research questions for the study include:

1. What are the major causes flooding in the study communities?
2. What are the effects of floods on households in the study communities?
3. What adaptation and mitigation measures have been put in place to address flood disaster in the study communities?
4. To what extent are the strategies effective in addressing the incidence of flooding?
5. What constraints do stakeholders face in implementing adaptation and mitigation measures?

1.5 Significance of the Study

The outcome of this study will serve as a tool for urban planning and administration. It will be very useful for institutions and agencies working on disaster management, especially those engaged in flood management in the city. The findings will also provide very good information for engineering work on drainage systems in the municipality and other cities in Ghana. Also, findings on flood mitigation and adaption financing will provide insight for planners, city authorities, government agencies and other stakeholders in exploring pragmatic sources of finance for flood adaptation and mitigation strategies. The study will again be helpful to households and community members in understanding the implication of their actions and inactions in inducing flood disaster. It will also helpful to them in identifying appropriate measures to take to minimize the occurrence of floods and flood disasters in the communities, and to ensure enhanced coping and recovery capacity. This study will also serve as reference material for students, institutions and individuals interested in floods for future research work. It

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will also contribute to knowledge in general in the sense that the final outcome will bring out new ideas, recommendations and approaches which will be relevant in addressing flood related problems.

1.6 Organization of the Study

The study was organized into five (5) chapters. Chapter one introduced the entire research by focusing on the background to the study, the problem statement, objectives of the study, research questions, significance of the study and organization of the study.

Chapter Two focused on literature review which discusses various themes under flooding such as causes of flood, socio-economic impact of floods on livelihoods, adaptation and mitigation strategies to flooding. It also discussed the conceptual framework for the study, explaining the relevant concepts and how they are related in the study

Chapter Three dealt with the research methodology which captured the research procedure for data collection. It specifically looked at profile of the study area, the study design, the sampling procedure, the data collection techniques, the instruments of data collection, data processing and analysis and limitations to the data collection.

Chapter Four focused on data analysis and discussion of the results using various quantitative and qualitative data analysis tools.

The Chapter Five which is the final chapter study looked at the summary of the study findings, conclusion, policy recommendations and recommendations for future research.

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CHAPTER TWO

REVIEW OF RELEVANT LITERATURE AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter of the study focused on the review of related literature on floods and flood disasters. The themes reviewed in this chapter include understanding of floods, types of floods, causes of urban flooding, effects of floods, historical trends of floods in Ghana, urban flood adaptation and mitigation perspectives, and flood adaptation and mitigation constraints. It also looks at the conceptual framework for the study, the gaps in the literature reviewed and conclusion.

2.2 Understanding of flooding

Flood is one of the leading natural phenomena that have caught the attention of most researchers and institutions across the world. In Ghana, several studies have been carried out on floods especially on those that occur in urban communities. In Accra for example, several studies such as (ActionAid International, 2006; Karley , 2009; Danquah 2013 and Attipoe 2014) have been carried out to understand the flood situation. This not withstanding, perrenial flooding remains the most destructive natural phenomenon in the city. On 3rd June, 2015 for example, the country experienced one of the most horrifying moments in its history, when hours of severe rain storm led to the Odaw river and its tributary gutters overflowing their banks and running through the streets of their adjoining communities including Kwame Nkrumah Circle and its environs. This coupled with oil leakage at a Goil filling station at Circle and a fire spark, resulted in an unpresedented fire outbreak which took over 150 lives, caused various degrees of injuries on hundreds of people and destroyed houses and worth of properties (Gadugah, 2016).

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Even though there is no universally accepted definition for flood, some working definitions have been used by couple of researchers and instiutions over the years to explain the term. For example, Jonkman & Kleman, (2005:78) in a study to investigate and improve understanding on the causes and circumstances of flood disaster deaths, defined flood as "the presence of water in areas that are usually dry and hence significantly disrupting or interfering with human and social activities". Also the WHO Regional Office for Europe, (2010:7) defined flood as "an increase of water that has a significant impact on human life and well-being". Guha-Saphir *et al* (2015:44) also defined flood as "a general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than-normal levels along the coast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or near the point where the rain fell (inland flooding)".

According to (Doswell, 2003) flooding is arguably weather-related hazard; it is often seen as a result of heavy rainfall – thus the origin of floods lies in atmospheric processes creating precipitation. This notwithstanding, a complete description of floods will include other processes that may have nothing to do with meteorological events such as the nature of the channel through which water passes, the soil texture, the topography of the land, human activities along water path and many more (ibid).

2.3 Types of Floods

Floods are categorized into various types by various authors based on the nature in which they occur. The following types as identified by (Attipoe 2014; ActionAid International 2006 and Doswell 2003) are discussed: Riverine Floods, Coastal Floods, Flash Floods, and Inland or Areal Floods.

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2.3.1 Riverine Flooding

According to (Attipoe, 2014:19), riverine or river floods occur "when the capacity of a watercourse is exceeded or the channel is blocked or restricted and excess water spill out from the channel onto adjacent low-lying areas". Maddox (2014) also postulates that, riverine floods usually proceed excessive rainfall which extends over a period of time causing a river to exceed its capacity. The river discharge however does not respond instantly to rainfall inputs since little of the rain will fall directly into the channel. If the channel receives so much overland flow, then it is likely to respond faster to rainfall and have a greater risk of flooding. When more water is able to permeate through the soil and travel to the river through groundwater flow, there will be slower rise in water level and the risk of flooding will be lower (Ace Geography, 2016). Also the nature of the river basin, the soil type, the vegetation, the cross section area of the river affects the magnitude and the risk of river flooding. Besides, certain anthropogenic activities such as urbanization and deforestation also contribute to flooding by increasing overland flow which results in modification of a river's hydrograph (ie the curve of river discharge over time) (McGuire *et al,* 2004).

2.3.2 Coastal Flooding

Coastal flooding occurs at areas that lie at the coast of a sea, ocean or other large water body. It occurs when the sea level rises higher than normal. According to the United Kingdom Environment Agency (2014), coatal flooding happens when there is high tides and stormy conditions. The storm surge is produced when high winds from hurricanes and other storms on the ocean push water onshore which overwhelms the low-lying land along the coast.

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2.3.3 Flash Flood

Flash flood is a flood characterized by rapid and extreme flow of water onto a normally dry area following an intense rainfall resulting in rapid surge of rising flood waters (National Weather Service Organization , 2002). It occurs when rainfall event is so high that the ground cannot absorb the water quickly enough to prevent significant runoff. Flash floods come with high velocity, carry high volums of debris and usually come with no warning. Due to the speed with which it occurs, flash flood causes more severe damages than ordinary riverine flood will do (Ibid)

2.3.4 Inland or Areal Flooding

Unlike flash flooding, areal floods develop more gradually, it occurs when water gradually buildup or forms a pond to cover a large low-lying area or an open field following a prolonged moderate or heavy rainfall. Despite developing gradually, areal floods remain stagnant for a long time before drying hence serving as breeding ground for insects and diseases (National Weather Service Organization , 2002).

2.4 Causes of Urban Flooding

Flood events arise out of several factors. Oppong (2011) and NIDM (2012) categorize these into natural causes and anthropogenic or artificial causes. The natural causes are those that do not have any direct human influence and the artificial causes are those that arise from the activities of humans in their intereaction with the environment, examples including urbanization and land use changes. In a study by Amoako & Frimpong, (2014) on the three dimensional causes of flooding in Accra, the natural causes of floods were further sub-categorized into meteorological causes which include rainfall and storm surges and hydrological causes which are relative to

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impervious nature of urban land scape. The studies on the causes of flooding in urban areas including (Twumasi & Asomani-Boateng 2002; ActionAid International 2006; Karley 2009; and Rain, Engstrom, Ludlow, & Antos, 2011; Attipoe 2014; Amoako & Frimpong 2014) are reviewed below.

2.4.1 Natural Causes of Urban Flooding

Several Studies have been carried out on the natural conditions that induce flooding in the urban centres across the world. A study by Attipoe (2014) in Dlefe and Aladjo in the Greater Accra Region of Ghana for instance revealed that natural phenomena such as heavy and prolonged rainfall and location of communities to the coast increase the possibility of their exposure to flooding and flood disasters. Similarly, studies by Opondo (2013) at Budalangi district in Western Kenya, and Tempels (2010) at Flanders in Belgium found that floods follow extreme meteorological events such as heavy and prolonged rainfall. They further argued that these climatic events are likely to increase in occurrence due to recent climate change variability. Commenting on the rainfall pattern in Greater Accra Region, Agboku (2016) observed that, although the region receives the least average annual rainfall in the country (600mm – 800mm) as compared to other zones, it is noted for experiencing heavy and prolonged rainfall frequently. Xeflide & Ophori (2007) in a study to predict the probability and frequency of heavy rainfalls in Accra also observed that, rainfall pattern of a maximum of 84.05mm in 1 day, 91.60mm in 2 days, 100.40mm in 3 days, 105.67mm in 4 days and 109.47 in 5 days is expected to occur in Accra every two years. Similarly a maximum of 230.97mm, 240.49mm, 272.77mm, 292.07mm and 296.54mm is expected to occur in 1 day, 2, 3, 4 and 5 days respectively in every 100 years

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Other studies have cited the nature of the soil as contributing factor to induce or prevent flooding. A study by Sampson (2014) to prove the correlation between soil permeability[3] and Flooding using the north-east sector of the Dog River Watershed in Alabama, USA, found out that, there is a very strong correlation between soil permeability and flooding. The study identified that, water infiltrates higher in soil that have higher permeability than those that have lower permeability. Hence higher permeable soils are able to prevent flooding or recover from it faster than lower permeable soils (Ibid)

The topography of the land has also been cited by some literature as major natural factor contributing to floods in some urban areas. Oppong (2011) and Nelson (2013) for example argue that flooding is more prevalent in low-lying areas or lowlands as compared to high lands. This is because, the flow of water on lowlands are usually slow as compared to relative high lands. Okyere, Yira & Dominik (2012) however argued that both lowlands and highlands are contributers to floods. In their view, whereas slow movement of water on lowlands result in high runoff water retention rate, highlands further increase the volume and velocity of floods in adjacent lowlands in the sense that the water that flows from highlands usually gather at the adjoining lowlands at faster rate hence paving ways for floods.

Also seismic[4] activities such as those caused by tsunami and earthquakes are identified by some literature as major causes of floods. In the views of Attipoe (2014), coastal areas are more vulnerable to floods induced by tsunamis and earthquakes than inland areas.

[3] the ease at which water, air or gases can move through a layer of soil
[4] Relating to earthquake or to other tremors of the earth such as those caused by explosion

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2.4.2 Anthropogenic Causes of Flooding

In as much as flood is seen as a natural hydrological event induced by natural phenomena such as prolonged and heavy rainfall, seismic activities, the slope and size of water basin, soil texture and land topography, the frequent exposure and vulnerability of urban communities to floods are better explained by developments in the urban communities caused by human interactions with the environment. Several human factors have been identified by literature for contributing to perennial flooding in most urban areas in recent times. These include poor physical planning and poor drainage system (Karley, 2009 & Attipoe 2014); poor waste disposal management resulting in choked drainage channels (Asumadu-Sarkordie *et al* , 2015); urbanization and sprawling urban development (ActionAid International, 2008 & Rain *et al,* 2011); land use changes resulting in impervious urban surfaces (Konrad, 2016); ineffective enforcement of settlement codes and building regulations resulting in increase in unplanned and informal settlement (Halou 2011).

Citing Amidu (2010), Okyere *et al* (2012) identified defective engineering works, building on waterways, changes in land use practices as result of urbanization; poor land administration and planning, poor sanitation and lack of drain maintenance; obstructive activities by utility agencies among others as factors that contribute to floods in Ghana.

According to the study by Karley (2009), an analysis of rainfall time series data in Accra showed that recent rainfall pattern is not unusual and that could not explain increased occurrence of flood in the city in recent times. Rather, he argues that the floods in Accra can be attributed to inadequate drainage facilities to collect the storm water for safe disposal. This could also be attributed to the ineffective planning regulations which ignore or condone the illegal erection of building and other structures on water ways, and the habit of indiscriminate dumping of refuse

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and other solid wastes in open channels. He therefore recommended sustainable urban drainage systems as a long-term solution to perennial floods in the city.

Similar to Karley (2009) and Okyere *et al* (2012), Tumpale *et al* (2012) carried out a study in Keko Muchungwa, Dar es Salaam in Tanzania. The study sought to ascertain the factors behind the perennial flooding of the community and also to assess the household and community coping strategies to floods. In the study, factors such as lack of coordinated storm water drainage system; haphazard housing development, haphazard dumping of solid waste which choke water ways were identified as the major causes of flooding in the community.

ActionAid International (2006), in a study involving six selected cities from six African Countries namely Lagos in Nigeria, Free Town in Sierra Leone, Nairobi in Kenya, Kampala in Uganda, Maputo in Mozambique and Accra in Ghana see urbanization as major factors that contributes to floods in towns and cities in Africa. It observed that increasing concentration of people in the towns and cities due to rural-urban migration has resulted in rapid growth of informal and unplanned urban settlements especially in developing countries. The study further identified that flooding in developing countries is most prevalent in urban informal settlements where layouts are poor and construction of shelter is done without any respect to settlement planning and regulations. People end up raising permanent structures on water ways which block drainage channels hence restricting free flow of runoff. These developments expose most informal urban communities to flood risk even with moderate rainfall. A later study by Rain *et al* (2011) involving informal settlements in Accra affirm these observations. They observed that, the massive growth of the city of Accra has increased the extent of impervious surfaces which leads to increase discharge that overwhelms the drainage channels in the city. In addition to this, Rain *et al* (2011) observed that flaws in drainage network, poor development control and limited

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garbage collection and disposal in the city block channels and sewers which slow drainage through the city.

Assumadu-Sarkodie *et al* (2015) also identified in another study that, poor waste disposal and management is a major factor contributing to floods in cities of most developing countries. In Accra, waste collection and disposal is yet to reach acceptable standards. It is estimated that between 1,800 – 2000 tonnes of solid waste are generated in Accra daily and out of these, only 300 – 500 tonnes are collected daily (Green Ghanaian Initiative, 2013) with the excess left on the street and found in drains during rainfall.

In another study, Konrad (2016) attributed floods in the urban areas to increasing land use changes observed in most urban centres across the world. The study argued that, contrast to undeveloped areas like grassland and forest where the vegetation and the natural soil layer help runoff water infiltrate into the ground easily, in towns and cities, much of the land surfaces are covered by roads and buildings and so have become more impervious for runoff water to drain. Construction of roads and buildings often involve the removal of vegetation and surface soil. Permeable soil is replaced with impermeable surfaces such as roads, pavement blocks, rooftops, parking lots and sidewalks among others that store little or no water, hence reducing the rate of infiltration of water into the ground. These developments, coupled with the construction of drainage networks increase the volume of runoff to streams, hence increasing peak discharge volumes and frequency of floods in nearby streams (Konrad, 2016)

Flooding in most urban centres can also be attributed to improper enforcement of building codes and settlement regulations (Halou 2011). Poor enforcement of development regualtions pave way for people to put up their permanent structures at unapproved places such as water ways, and

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flood plains. These developments increases the risk of surrounding neighbourhood for experiencing flooding even at a moderate rainfall. The World Bank Group (2013) study to improve the efficiency and effectiveness of building code regulatory system for disaster risk reduction for example identified that building codes have consistently been desregarded in building urban disaster resilient environment in majority of developing countries. According to them rapid urbanization without effective building regulation has dramatically increased urban disaster risk through out the developing world. In their estimation about 325 million urban poor will be exposed to various kind of natural disaster including floods by 2030 due to unregulated urbanization (World Bank Group, 2013).

2.5 Effects of Flooding

The effects of floods on urban comunities are diverse and more often very gravious: it affects every aspect and structures of the society. Some negative effects of flooding identified in various literature include the following:

Floods can lead to diverse economic loss. Floods can cause damages to public buildings, public utility works, housing and house-hold assets. It can affect industries by destroying the whole industrial set-up including their building, machines, vihicles and raw materials among others, and bringing production to standstill. Floods can also destroy the investment of petty traders and shop keepers in just a nitch of time, dashing the hopes and aspirations of affected persons. Millions of revenue can also be lost through road and railway transportation interruptions caused by floods. Between 2000 and 2016 a total economic damage of US$ 450 billion was inccured globally and US$ 5.9 billion in Africa through flood events (EM DAT, 2016). In Ghana, the World Bank assessment of the 3rd June, 2015 flood disaster extimated that, a total economic

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damage of GH¢ 242 million, equivalent US$ 55 million was incurred through the disaster in only the water, transport and housing sectors (World Bank, 2016). Besides, recovery and reconstruction schemes for flood disaster which are very costly, put pressure on the national purse. In Ghana the estimated cost of recovery and reconstruction following the June 3rd, 2015 flood disaster was US$ 105 million (World Bank, 2016).

The most damaging effect of floods is the high fatality rate associated with it. Among all natural disaster confronting the world, flood is the one with highest fatality. Between 2000 and 2016, an estimated 92,062 (annual average death of 5,753) lives globally and 12,929 (annual average death of 808) in Africa were lost through flood events, and 1.8 billion and 45 million people respecively were affected in diverse ways (EM DAT, 2016). Flood events in Ghana over the years have also resulted in a number of fatalities; for example, as many as over 150 deaths were recorded and over 52,000 people affected during the 3rd June, 2015 floods in Accra (World Bank, 2016). Similarly over 35 and 14 deaths were recorded on 22nd june, 2010 and 1st November, 2011 respectively through flood events in various parts of the country (Graphic Online, 2015). According to Jonkman & Kelman, (2005) two-thirds of direct deaths from flood events occur through drowing and one-third through physical trauma, heart attack, electrocution, carbon monoxide poisoning or through fire.

Again during floods, the breakdown in sanitation system and the contamination of water sources can result in the outbreak of various water-borne diseases such as chorela which may be contracted through drinking or coming into contact with contaminated water source. For instance the West Bengal-India floods in July 1998, resulted in a severe chorela outbreak that affected over 16,590 people and claimed over 276 lives (Sur, Dutta, Nair, & Bhattacharya, 2000). In Bangladesh, the greater percentage of flood-induced deaths are found to have been caused by

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diarrhoea and other water-borne diseases, or from drowing and snake bite. Jonkman & Kelman, (2005) however argue that, the risk of flood-induced water-borne diseases are dependent on several factors such as the characteristics of the population displaced, the proximity of safe water and functioning latrines, the nutritional status of the displaced population and access to healthcare. The incidence of vector-diseases such as malaria may also increase during floods. This usually occurs when flood waters remain stagnant, hence serving as breeding ground for mostiquitos and other vectors.

Floods may also result in various degrees of injuries on the people who may be exposed to it. The most commonly reported flood-injuries, according to World Bank & GFDRR (2012) are sprains and strains. People may be injured as they attempt to escape, through collision with objects carried by fast-flowing water, collapse of building or through electrocution (Du, Fitzgerald , Glark, & Hou, 2010). At the pre-onset stage, people may secure injuries as they attempt to move themselves, their families and their valuable possessions to safer places (Ahern & Kovats, 2005).

Floods may also result in displacement and rendering people homeless. During flood events, people whose houses are evaded by water are forced to vacate and relocate to safer places. Usually such people are provided temporal abodes in public buildings or in open spaces during the period of the flood with all the associated inconveniencies. Graphic Online, (2015) revealed that, the flood events which occurred in various parts of the country on 18th October, 2010, 25th July, 2011 and 1st November, 2011 displaced 161,000 people in; 43,000 and 43,087 respectively.

Floods also have significant detrimental effect on the environment and the ecosystem. This may come in various forms such as soil erosion, bank erosion, land sliding, destruction of vegetation,

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water and land pollutions caused by pollutants carried by flood water, destruction of acquatic life and arable lands among others (Addei, 2016). Severe flooding can also create channels and gullies on the street and roads making some of them death-trap for users (Ibid).

The mental trauma caused by witnessing deaths, injuries and destruction of homes and valuabe properties during floods, can result in severe psychological effects (World Bank & GFDRR, 2012). The grief about deceased family members and neighbours, thoughts about property loss, as well as the physical health problems and the general inconvenience associated with displacement, can lead to depression or anxiety. Ahern & Kovats (2005) noted three types of mental health issues that occur to people during floods: common mental health disorders, post-traumatic stress disorders and suicide.

Flood events can lead to general inconveniences. Destructions caused by floods to transportation network, communication network, utility supply; obstructions in domestic, commercial activities and services as well as the general pollutions associated with floods make life very uncomfortable for flood victims (World Bank group, 2013)

2.6 Classification of Effects of Floods

The negative effects of flooding are classified into various categories by some literature. These are tangible and intangible impact (OPW 2003); direct and indirect impacts (Gautam & Hoek, 2003) and primary, secondary and tertiary impacts (Nelson, 2013).

2.6.1 Tangible and Intangible Effects of flood events

This classification of effects of flood events is based on whether or not the impact can easily be measured in monetary terms (OPW 2003). The tangible impacts of floods can easily be measured in monetary terms. Example include damage caused to households' assets such as building,

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furniture, electrical appliances, vehicles, cooking utensils, food stuff, fabrics etc. The cost of the damage caused by the floods to these assets can be valued using various methods depending on the nature of the asset involved. These methods include, using their current market prices if the assets were new; the market price of the asset adjusted for depreciation if the assets were used; the net selling price, which is defined as the selling price minus the cost of selling the assets; cost of restoring the asset to its original state before the floods and by using "income capitalization method"[5] if the damaged asset would have lasted for longer time Dixon et al (1994). Other tangible cost of flood events include cost of evacuation, clean-up cost, cost of restoring public utility and services, cost of providing emergency services and alternative accommodation cost among others (OPW, 2003). The intangible impacts of flood events on the other hand are those that are extremely difficult to measure in monetary terms such as stress and mental trauma caused by the flood event itself and the worry of future flooding; damage to health; loss of life; loss of memorabilia or other irreplaceable and non-marketed assets; disruption in the normal way of life and possible evacuation and migration (Smith & Ward, 1998).

2.6.2 Direct and Indirect Impact

The direct impacts of floods are those that occur due to the direct or physical contact of people, their properties or animals with the flood water. These include loss of life through drowning, collapse of building and bridges, destructions of machines and home appliances due to soaking by flood water, carrying away of household and community assets by the running water, destruction to farmlands, etc. The Indirect impacts of floods on the other hand are induced by the flood event; however, they often occur away from scene of the events or after the events have occurred. Example is stress induced sickness, disruption in communication network, disruption

[5] The method is used to value the total damage caused by floods to an asset by estimating the net income for the remaining life of the assets and adjusting its current price.

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of transportation system due to collapse of bridges, outbreak of water borne diseases, disruption in energy supply etc. Nelson (2013) however classified the direct and indirect impacts of flooding into primary and secondary impacts respectively and further included tertiary impacts which capture the long term effect of flood disaster. For example jobs may be lost due to destruction of businesses, increase in poverty due to loss of source of livelihood through flooding and the long term implication of loss of a family member especially the bread winner (ibid).

2.7 Historical Trends of floods in Ghana between 1968 and 2016 and their effects

Ghana has a long history of exposure to floods. An exploration of newspaper reports on flood incidence in the country reveals that, the country's exposure to floods can be traced as far back as the 1960s. On 4th July 1968 the entire capital city, Accra was inundated following heavy downpour that lasted for over seven hours (Graphic Online, 2015). Two years after, on 29th June 1971 the Twin-city of Sekondi-Takoradi was also worse hit by floods, raiding down hundreds of houses and rendering thousands of people homeless. Between 1995 and 1997 heavy downpour in Accra flooded the entire city on 4th July 1995 and 13th June, 1997 as major drains such as Odaw river and Onyasia broke their banks claiming lives and properties; halting vehicular commuting for hours and destroying the Achimota VRA substation resulting in power cuts. Similarly, flood incidence in 1999 in Upper West, Upper East, Northern and parts of Brong Ahafo and Volta regions affected over three hundred thousand (300,000) people. Between 2000 and 2005, various flood cases were recorded in Accra, Bunkpurugu in the Northern Region and Kasoa in the Central Region claiming hundreds of lives and destroying hectors of farmlands and properties worth millions of Ghana cedis (Pan African News Agency, 2002; Ghana Web, 2003; Ghana web 2004;Ghana Web, 2005; Graphic Online, 2015). Between 2006-2008, floods in Afife in the volta region, Upper West, Upper East, Northern Regions and Accra halted vehicular movements on

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Accra Aflao High way; affected three hundred and seven thousand, one hundred and twenty–seven (307,127) people in the three Northern regions, washed away properties worth millions of cedis and rendered hundreds of people homeless in Accra (Ghana Web, 2006; Ghana Web, 2008; Graphic Online, 2015).

In 2010, several flood cases were reported in the dailies. These include the floods which submerged Cental Accra, Ofankor and Begoro on 5th May, 2010; and the floods on 22nd June, 2010 recorded in various parts of the country which claimed about 35 lives. On 24th June, 2010, the whole city of Agona Swedru and its neighbouring communities were cut off as the main bridge connecting the town to its neighbouring communities collapsed resulting in an unprecedented floods that destroyed properties worth millions of Ghana Cedis and affected over three thousand (3000) people. Again over 161,000 people nationwide were displaced on 14th October 2010; 55 communities in the Northern region were submerged on 18th October 2010 and 2,800 from 120 communities in the Volta region were displaced on 2nd November 2010 as result of floods in all of these ocasions (Graphic Online, 2015).

In 2011 several floods events were recorded. For example, following about six hours of heavy downpour, floods caused havoc in Accra on 24th February, 2011. Similarly, floods left 105 farmers stranded on farm at Akyem Osoroase in Atiwa District in the Eastern Region on 25th July, 2011. On 1st November 2011 over 43,000 people were displaced in Accra and 14 death recorded following a heavy downpour. Similarly records of floods in Accra in 2013 and 2014 destroyed properties worth millions of cedis and brought life to standstill (Graphic Online, 2015). In 2015, the country experienced the darkest moment of all time, as floods coupled with fire, claimed over 150 lives at Circle (a business centre in Accra) on 3rd June, 2015 following a heavy downpour that caused the Odaw River to outflow it banks and flooded Circle and its

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vicinities. Similarly on 10th June 2016 floods submerged most communities in Accra following hours of heavy downpour which brought life in the city to standstill.

2.8 Flood Adaptation and Mitigation Perspectives

2.8.1 Flood Adaptation

IPCC (2001:887) defined adaptation as "an adjustment in natural or human systems in response to actual or expected climatic stimuli and their effects. It involves changes in processes, practices, or structures to moderated or offset potential damages or to take advantage of opportunities associated with changes in the climate". Three main types of adaption strategies are identified by the IPCC (2001) which are anticipatory adaptation, autonomous adaptation and planned adaptation. Anticipatory adaptation includes those measures put in place before flood event occur as a way of reducing its possible impact. Autonomous or spontaneous adaptation takes place in direct response to ecological or economic impact of flooding. That is, the autonomous adaptation strategy is not basically planned, and they are done usually at the household level or community level in direct response to flood events. Planned adaption emerges out of deliberate policy decision by public agency, based on the awareness that conditions have changed or are about to change and that deliberate actions are needed to minimize losses.

2.8.1.1 Flood Adaptation Measures at the Household and community level

To moderate or offset the degree of damages caused by flood disasters, households respond to floods using various anticipatory and autonomous adaptation measures. In Tumpale *et al* (2012) studies at Keko Muchungwa, Dar es Salaam in Tanzania, the household adaptation strategies identified include using sandbags and tree logs to block flood water and prevent erosion; raised

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doorsteps and pit latrines; construction of protective walls, installation of pipe outlets to drain off flood water from the compound and the elevation of house foundations. At the community level, community-based initiatives such as promoting effective solid waste management practices and community protest against putting up buildings at unauthorized places especially those that sit on waterways among others were cited. Douglas *et al* (2008) also studied about Climate change and floods in selected poor urban communities in five cities in Africa using secondary data from reviewed literature and documents. The study acknowledged that climate change variability coupled with some anthropogenic factors have made flooding a common phenomenon in those cities. Residents however adopt various coping strategies to floods such as the use of blocks and stones to create high places on which to put their most valuable items, keeping goods on top of wardrobes and small spaces between the ceilings and roofs; temporally relocating to stay with friends and families; digging trenches to divert water away from building; using sand bags to prevent ingress of water; relocating to the highest parts of the house where residents think they are safe among others. At the community level, the adaptation strategies identified were weeding around drains and clearing choked gutters to enhance their carrying capacities and improve smooth flow of water; communal evacuation of affected people and their properties to safer places and the establishment of standing community rescue teams to provide rescue services for flood victims.

2.8.1.2 Institutional Level Adaptation

Adaptation to flooding is not preserved for only households and community members. Usually City authorities and other state institutions complements the efforts of households and communities with more comprehensive and enhanced adaptation programs ranging from anticipatory adaptation to planned adaptation. In Attipoe (2012) study for example, the local

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authority and some other state institutions were cited as relevant in designing adaptation programs for households and communities. These included National Disaster Management Organization (NADMO); Hydrological Services Department (HSD); Town and Country Planning Department (TCPD) at the Assembly among others. Heikkila & Huang (2014) in their studies on adaptation practices to flooding in urban areas using cities of Orleans in France and Bangkok in Thailand made three recommendations for city authorities for effective flood adaptation. These were physical modification to the environment through adaptive topography and adaptive infrastructure; land use modification to locate or relocate vulnerable populations away from flood-prone areas; concentrating efforts on clean up and effective recovery after floods. In Keko Muchungwa, Dar es Salaam in Tanzania, the institutional adaptation strategies identified by Tumpale *et al* (2012) include dredging of drainage channels prior to raining season, evacuation of residents of flooded communities to safer places, provision of relief services to flood victims, the use of early warning system, preventing the building of unauthorized structures along drainage channels and on water ways among others. Also the World Bank & GFDRR (2012) in their comprehensive guide for integrated urban flood-risk management, recommended an immediate installation of recovery programs to reduce as much as possible the secondary impacts of floods. Some recommended recovery programs include the need for quick repair or restoration of crucial installations such as roads, bridges, electricity generation and supply, water treatment supply, telecommunication, health facilities among others to bring life back to normal. Also the need for quick clearance of high volumes of solid waste deposited on the street by floodwater to allow for easy reconstruction.

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2.8.2 Flood Mitigation

Flood Mitigation is defined by the Association of State Floodplain Managers (2007) as steps taken to eliminate or reduce the long-term impacts of flood hazards. These are grouped into Structural and Nonstructural Measures. Structural Mitigation measures include physical constructions to reduce or avoid possible impact of flood hazard. It also means the application of engineering techniques on structures or systems to enhance their hazard resistance and resilience. The nonstructural measures on the other hand do not involve physical construction; they are knowledge, practices, agreements or regulations to reduce flood-disaster risk and impacts, in particular through policies and laws, public awareness campaigns, training and education (UNISDR, 2017). Some common structural measures for reducing flood risk include establishing or expanding dams, flood levees, ocean wave barriers among others; and some common nonstructural mitigation measures include building codes, land-use planning laws and their enforcement, research and assessment, information resources and public awareness programs (Ibid).

2.8.2.1 Structural approaches to flood mitigation

The structural approaches to flood mitigation range from the use of hard-engineered solutions to more natural and sustainable alternatives such as the use of wetlands and natural buffers to manage flood risk. The engineering approaches recommended by the World Bank & GFDRR (2012) include the modification and enlargement of drainage channels to increase their carrying capacities; the use of dams and retention ponds to hold high volumes of water and regulate discharge downstream; the establishment of storm drains to carry storm water to desired destination; the use of flood defenses such as flood walls and sea defense walls to protect nearby communities from riverine and coastal flooding during peak discharge; the installation of

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infiltration and land permeability management devices such as soak aways, filter drains, infiltration basins, vegetated surfaces and permeable pavements to improve rate of infiltration during rainfall; the use of floodways[6] to provide temporary storage for storm water during periods of high discharge; and more traditionally by building storage facilities or reserviors to harvest rainwater for varied use (World Bank & GFDRR, 2012)

Following the 3rd June, 2015 Circle flood disaster in Ghana, the World Bank assessment team made some recommendations for flood mitigation; these among others were structural measures such as desilting primary and secondary drains, rehabilitation and replacement of culverts, widening of drainage channels and reconstruction of 29 km roadside drains (World Bank, 2016).

2.8.2.2 Non-structural mitigation approaches to urban flooding

The non-structural mitigations are regarded by World Bank & GFDRR (2012) as more sustainable and less costly than structural measures with the argument that, the structural installations can fail, which implication can be more disastrous. Some non-structural mitigation approaches identified or recommended by literature are reviewed in turn.

Mitigation through flood awareness campaign – In the views of World Bank & GFDRR, (2012) flood awareness campaign is the cornerstone of all the non-structural approaches. An awareness campaign helps to reach the unreachable groups in the society. Carin *et al*, (2013) study in Western Cape Province in South Africa opined that, flood risk awareness campaign increases the resiliency and the preparedness of communities towards flooding. In designing flood awareness campaign, different interest groups including government institutions, local authorities, business

[6] Floodways are river channels or other watercourse and its adjacent land areas that are reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height (FEMA, 2017). Example of areas used for floodways are parkland, playing fields, and car parks; they are used for the primary purposes when there are no rains; however during high discharge, they provide outlets or temporal storage for storm water

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agencies and individuals should be targeted and diverse approaches should be adopted based on the characteristics of the target audience and the resources available including the use of radio, television, newspapers, magazines, information centres, durbar and seminars, drama, lectures, etc. The World Bank & GFDRR (2012) have recomended that for flood awareness campaign to be effective implementation shoud be sensitive to local cultures, conditions and perspectives; all sectors of the society should be targeted, including both decision makers and members of the public, including children; messages should be targeted at the appropriate level for each interest group; and also campaigns shoud be sustained over time, with regular monitoring of their success.

Land use planning and floodplain zoning are also used for mitigating flood and flood disaster. Land use planning involves laws and regulations that provides detail guide on ways in which building and land must be used. In growing expansion of urban settlement, structural developments may occur with less consideration to flood hazard. These development have resulted in increasing rate of urban slums in modern cities who are usually vulnerable to floods and other disasters. An integrated land use plannning therefore will serve as a tool to guide urban development in a desired manner (World Bank & GFDRR, 2012). In such planning, flood plains and water courses are zoned out, and laws or regulations that prevent or limit building and development in flood zones are enforced to lessen the risk of flooding. Flood plains are rated by (FEMA, 2017) based on the severity, frequency and the types of flooding that occur in these areas and are designated as low-to-moderate risks, high risks, coastal areas, and undetermined risks; and based on these ratings, suitable land use planning are designed.

Again early warning system (EWS) can be used as a tool to prevent floods or reduce the risk associated with it. EWS are used to give advance notice of an impending flood, allowing for

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emergency plans to be put in place. To ensure a people centred early warning system, Basher, (2006) argued that effective EWS should have four key elements; namely, knowledge of the risks; monitoring, analysis and forecasting of the hazards; Communication or dissemination of alerts and warnings; and local capabilities to respond to the warning received. The warning system can only be effective if all the four components are effective. The early warning system can be done through the combination of the following media telephone, text, email, fax warning services, local and national radio, television and press, sirens, drums, flag warding service, road signs posters (World Bank & GFDRR, 2012) and through the word of mouth. The content of the message should be appropriate to the context and understanding of the audience.

Floods and flood risk can also be controled significantly through effective solid and liquid waste collection and management. Inadequate collection and disposal of waste contribute significantly to urban flooding (Oppong 2011; World Bank & GFDRR 2012; Attipoe 2014 & Addei, 2016) by blocking the flow in drains and watercourse, or by by filling low lying areas which would have otherwise serve as temporary storage for flood water. Effective waste management practice is therefore necessary to control floods Oppong (2011), and its success will be highly dependent on a culture of awareness on the importance of solid waste management and conservation of resources (Addei, 2016). To cut down the high volumes of municipal waste, the World Bank & GFDRR (2012) recomends regulations and incentive packages for recycling and reuse of solid waste by both domestic and industrial waste generators, and also through regular collection of waste by public and private organizations to save the urban drainage system from getting choked with waste.

Again flood insurance, risk financing, compensation and tax relief can be used to mitigate and ofset the damages caused by floods to individuals (Swenja & Delioma, 2013). World Bank &

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GFDRR (2012) have argued that these financial tools can be used to achieve two main purposes in flood risk management. Firstly, the schemes can be used by those at risk to oftset their financial risk from flooding. In as much as these financial schemes do no prevent flooding, they allow for expedite recovery without placing undue financial burden on those affected by the flood disasters. Secondly, flood insurance, compensation and tax relief schemes help to reduce flood risk and damage through the need for risk assessment and emphasis on risk mitigation by policy holders as requirement for insurance coverage. That is, flood insurance schemes require policy holders to undertake some reasonable risk reduction and mitigation activties before taking insurance cover. Similarly, compensations and tax reliefs are also granted on the basis of flood risk reduction or mitigation efforts by beneficiaries (World Bank & GFDRR, 2012). The World Bank & GFDRR, (2012) however have argued that there are dangers of adverse selection and moral hazard associated with flood insurance. With adverse selection, there is high probability for subscribers of flood insurance schemes to be residents of high flood-risk comunities than those from low flood-risk communities; hence putting undue pressure on the scheme. The moral hazard problem will occur when there is no reward package for risk mitigation behaviour built in the insurance scheme; Policy holders will rely on the insurance scheme to ofset their lost and so will not undertake any self-protection (ibid).

Again effective evacuation planning can help mitigate the possible damages caused by flood disasters. There should be comprehenive flood emergency plans for both pre-flooding and during-flooding evacuation (World Bank & GFDRR, 2012). The pre-flooding evacuation will usually follow an early warning system, and this will help to avoid the damages caused (World Bank & GFDRR, 2012). For example during pre-flooding evacuation in Keko Muchungwa, Dar es Salaam in Tanzania,, indiduals, properties and animals were removed from the facility at risk

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to safer places and some other properties were locked or anchored to ensure that they were not taken away by the floods (Tumpale *et al,* 2012). Also, during the event of floods, flood management unit should be set up to coordinate all the emergency procedure. This should include representation of all institutions and bodies that are directly or indirectly in charge of flood management. Representatives from the local community must be included in the management unit to improve trust and smooth communication. The flood emergency plan should make provisions for a wide range issues such as provisions for flood shelters and refuges for victims, emergency food supplies, emergency water supplies and sanitation, emergency access routes, emergency health facilities, alternative energy sources, communication channels security and many more (World Bank & GFDRR, 2012).

2.8.3 Importance of Wetlands and Buffer zones in flood management

Another structural but very natural and sustainable way of managing floods is through the use of wetlands and natural buffers. Azan, (2011) of the Jamaican National Environment and Planning Agency defined wetlands as area of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static, flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tides does not exceed six meters. Wetlands play a very significant role in the conservation of the environment and ecosystem in general (Lakis 2010; World Wildlife 2017; USEPA 2017). They are important in improving water quality, providing habitat for aquatic life and wildlife. In flood protection, wetlands serve as natural sponges that trap and slowly release surface water, hence reducing the volume and the speed of flood waters and distributing them slowly over the floodplain (USEPA, 2017). In the urban areas, the water holding capacity of wetlands helps to contain the high volumes of runoff water that are generated due to the impervious nature of urban land surfaces. The bottomland

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hardwood-riparian wetlands along the Mississippi River for example, could at a point store at least 60 days floodwater (USEPA, 2017). Like wetlands, buffer zones provide important services in flood protection. Riparian buffer zones are green areas along streams, rivers and lakes (Hayes-Conroy, 2000). Buffer zones helps in flood protection by slowing down the speed of run off into the stream, reduce the velocity of the stream and also serves as soak for excess water (Hayes-Conroy, 2000).

2.9 Constraints in Flood Adaptation and Mitigation

Floods are best managed through the collective efforts of multiple institutions including local, regional and national governments, community groups, specialized institutions, private businesses, NGOs, Civil Society Organization, International Organizations, Local and International Financial institutions, insurance companies and individuals. However studies show that households and flood management institutions are confronted with several challenges in managing flood and flood risks. Some flood management challenges identified by World Bank & GFDRR (2012) include lack or inadequate financial resources by stake holders to finance flood adaptation and mitigation measures; lack of proper coordination between activities of various stakeholders resulting in disjointed measures; inadequate capacities of authorities to enforce land use and settlement regulations; lack of engagement of the private sector in flood management; inappropriate infrastructure maintenance systems; shortage of skilled personel and technical know-how in flood adaptation and mitigation; discontinuity in adaptation and mitigation projects due change in government priorities; inadequate community involvement in flood management; lack of long-term national framework for addressing flooding and flood disaster. Another study by the World Meteorological organization, (2008) also identified six inefficiencies in urban flood management most of which are in line with the World Bank &

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GFDRR (2012) findings. These include lack of comprehensive risk assessment, lack of coordination among different flood management institutions, lack of information sharing, disintegrated flood investment decision, lack of consultation with stakeholders and non-factorization of flood risk in development plannning.

Wamler (2006) has argued that flood adaptation and mitigations schemes requires intensive financial commitments from government and other stake holders, however, these funds may be non-existence or insufficient for such projects. The situation is even worse in low income and middle-income countries where governments mostly rely on development assistance for flood management projects. In looking for development assistance governments are confronted with the reality that, the best opportunity for fund raising is generally after the flood disaster (Wamler, 2006). More so the urban poor, who are usually the residents in high risked areas, also lack the financial resources to invest in improve housing and installations that will enhance their resiliency to floods. Wamler (2006) further argues that, the fact that flood risk management measures may not offer quick returns to donors and government further limit the available funding opportunity.

2.10 Conceptual Framework

The Conceptual framework for this study is the Integrated Urban Flood Risk Management (IUFRM) Framework which was developed by the World Bank Group and the Global Facility for Disaster Reduction and Recovery (GFDRR) in 2012 as a guide for managing urban flood disaster in the 21st Century (World Bank & GFDRR, 2012). The framework is generally, a build up on the Integrated Flood Management Approach (IFM) by the World Meteorological Agency (WMO).

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As a guide, the IUFRM framework advocates for an integrated approach to urban flood risk management which combines structural and non-structural measures – an integration which is holistic in scope, strategic in content and collaborative in nature. The framework is built on the assertion that, the inevitability of urbanization in recent times coupled with the uncertainties in climate projections has made urban flood events almost unstoppable, and accuracy or precision in long-term flood risk forecast very low. In the face of these inevitable uncertainties, the framework advocates for flood risk management through a combination of multiple adaptation and mitigation strategies as a preferred and realistic approach over a seemingly utopian and unrealistic approach of total overhaul to floods.

The framework further admits that, urban flood events are caused by a combination of meteorological, hydrological and anthropogenic factors hence arguing for a more holistic approach which explores diverse combination of structural and non-structural measures for managing urban flood risk. The structural measures range from a hard-engineered structures such as flood defense, drainage channels, dams, levees and dikes to a more natural complementary or alternative measures such as wetlands and natural buffers which aim to reduce flood risk by controlling the flow of water both outside and within the urban settlement. The non-structural measures which include early warning system, flood awareness campaigns, land use regulations, emergency evacuation plans, health planning and awareness campaigns, floods insurance and risk financing among others aim at building the capacity of people to cope with flooding in their environment. They are categorized into four main purposes, namely, emergency planning and management including early warning and evacuation; increased preparedness via awareness campaign; flood avoidance through land use planning and speeding up recovery to enhance resilience by improving building design and construction (World Bank & GFDRR,2012).

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The IUFRM framework again advocates for wider participation and greater coordination between national government, city authorities, ministries, public sector agencies including utility providers, along with meterological and planning institutions, civil society, non-governmental organizations, educational institutions and research centres, private sector and individuals for sucessful management of urban floods. The efficient exploration and coordination of the capacities, incentives and expertises from these diverse institutions is the necessary ingredient for a more sustainable flood risk management. The framework specially emphasizes the relevance of communinity engagement for a more sucessful and sustainable adaptation and mitigation as it will promote local responsibility, trust and easy communication.

The IUFRM framework was chosen for this study because it is a very comprehensive tool for exploring the multiple dimensions of flooding in the urban centres. The framework is specially designed to address the unique nature of problem of flooding in the urban areas hence given comprehensive guide for urderstanding the multiple chains between the causes–effect–flood management interrelations for urban communities. The framework is very unique as it gives recognition to multiple players beyond the traditional local government and state institutions for addressing urban flood disaster problem. These players include civil society organizations, nongovernmental organizations, educational institutions and research centres, private individuals, financial institutions, insurance companies. The expertise and the capacities of these giants were not sought for in traditional urban flood management efforts. The framework emphasizes the coordination of the activities of the multiple stakeholders and expecially for the incorporation of household and community efforts in designing comprehensive program for addressing urban flood disasters. The conceptual framework for the Integrated Urban Flood Risk Management is shown in Figure 2.1.

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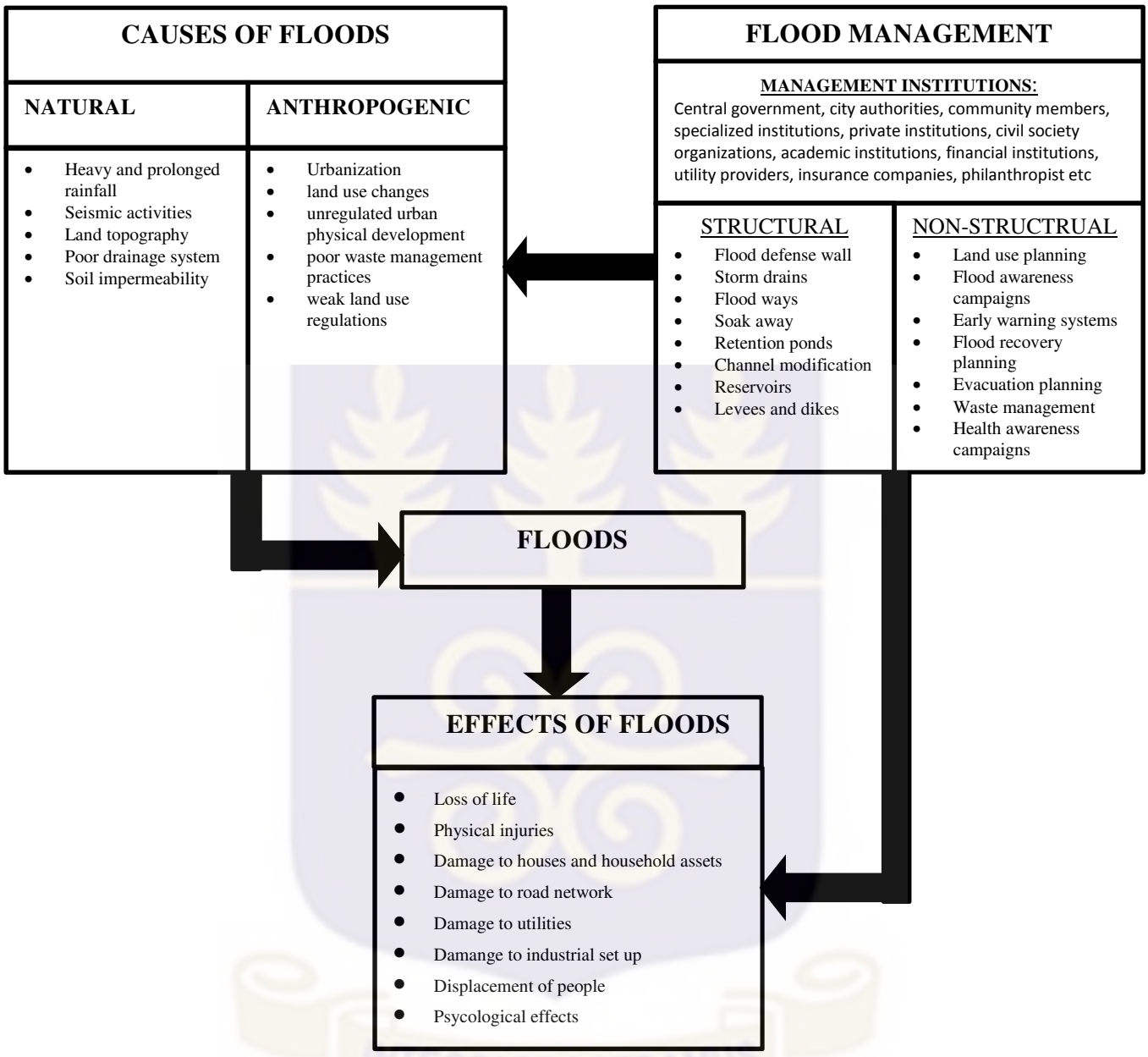
Fig. 2.1: Framework for Integrated Urban Flood Risk Management



Adapted from World Bank & GFDRR (2012)

2.11 Gaps in literature

Whereas several studies have been carried out on flood adptation and mitigation strategies by households and government institutions in the urban centres, little work has been done, on extent of stakeholders collaboration in managing floods. Attipoe (2014) for example looked at the role

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of various institutions such NADMO, Hydrological Service Department, Meteorological Service Department, Town and Country Planning among others in isolation without looking at how the various institution can collaborate or complement each other to ensure effective flood management. Also little attention has been paid to community involvment in designing pragmatic strategies to mitigate floods. That is, flood management planning is considered to emanate from official state institutions; what households do by way of adaptation and mitigation are not incorporated into the planning process. Also the financial bearings of flood adaptation and mitigation have not been given due attention by the literature reviewed. Flood adaptation and mitigation measures are discussed by the literature without any emphasis on the cost associated with them. Analysis of how households, communities and institutions finance flood management programs were not captured in the literature reviewed. Finally, not much attention was given by the literature reviewed to concept of flood insurance; that is, whether or not households would like to subscribe to flood insurance policies was not given attention.

2.12 Conclusion

This chapter reviewed extensively various studies carried out on urban flooding. Issues reviewed included understanding the meaning of flood, types of flood, causes of urban floods, effects of floods on urban communities, historical trends of floods in Ghana, urban flood adapation and mitigation perspectives and constrainst to flood adaptation and mitigation. The conceptual framework for this study was also higlighted to throw more light on the study. Generally this chapter is very relevant to the study as it gathers various perspectives and views on the incidence of urban flooding and the adaptatiom and mitigation strategies recommended for addressing urban flooding.

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CHAPTER THREE

PROFILE OF STUDY AREA AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with the profile of the study area and the research methodology. Under the profile of the study area, diverse issues such as the location, size, political and administrative divisions as well as the physical environment, demographic characteristics of the study areas, housing and residency, sanitation and environmental issues among others are captured. The research methodology also captures issues such as the study design; sources of data which are basically from primary and secondary sources; the instruments for data collection, population, sampling size determination, the sampling selection procedure as well as data processing and analysis procedure.

3.2 Profile of the Study Area

3.2.1 Location, Size, Administrative and Political Divisions

La Dade-Kotopon Municipality is one of the sixteen District Assemblies in the Greater Accra Region of Ghana. The municipality was carved out of Accra Metropolitan Assembly on 28th June 2012 with La (township) as its capital. The municipality lies on the coast of Accra between Latitudes 5°32"50' N and Longitudes 0°11"15' W and Latitudes 5°38"0' N and Longitudes 0°7"50' W with a total land area of 36.033 square kilometers which represents almost 1.1% of the total land size of the Greater Accra Region (LADMA, 2014). It is bounded on both the North and West by Accra Metropolitan Assembly, on the East by the Ledzokuku Krowor Municipality and on the South by Gulf of Guinea. The municipality is divided into 10 electoral areas, namely Adiembra, Adobetor, Ako Adjei, Burma Camp, Cantonments, Labone, Lakoo, New Kaajaanor,

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New Lakpaanaa and Tse-Addo/Mantease electoral areas which are organized under three zonal councils. It has a sixteen-member general assembly made up of 10 elected members representing the ten electoral areas; 4 government appointees, one Member of Parliament and the Municipal Chief executive. There are also an executive committee headed by the Municipal Chief Executive, 6 sub-committees, 13 functional departments and 50 unit committee members that perform various political and administrative functions (LADMA, 2014).

Fig 3.1 Location of La Dade-Kotopon Municipality in the Regional Context

Source: LADMA Planning Coordinating Unit (2014)

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3.2.2 Physical Environment

3.2.2.1 Geology

The geology of the Municipality consists of "Precambrian Dahomeyan Schists, Granodiorites, Granites Gneiss and Amphibolites to Precambrian Togo Series comprising mainly of Quartzite, Phillites, Phylitones and Quartz Breccias. Other formations found are the Palaeozoic Accraian Sediments-Sandstone, Shales and Inter-bedded Sandstone-Shale with Gypsum Lenses" (LADMA, 2014:26). Also the coastline of the municipality has a "series of resistant rock platforms and sandy beaches" especially around the mouth of the Kpeshie lagoon. However, as a result of close proximity of the "continental shelf" and strong "coastal wind", the coastline has been subjected to severe erosion in recent times (LADMA, 2014:26).

3.2.2.2 Soil

The soil of the Municipality can be grouped into four main categories. These include "drift materials resulting from deposits by windblown erosion; alluvial and marine motted clays of comparatively recent origin derived from underlying shales; residual clays and gravels derived from weathered quartzites, gneiss and schist rocks; and lateritic sandy clays soils derived from weathered accraian sandstone bedrock formations" (LADMA, 2014:26)

3.2.2.3 Climate

The La Dade-Kotopon Municipal Assembly lies in the Coastal Savannah zone. It has two main rainy seasons. The first season begins in May and ends in mid-July, and the second season begins in mid-August and ends in October, with an average annual rainfall of about 730mm (LADMA, 2014) . In some occasions, the municipality experiences thunderstorms and this gives rise to local flooding where drainage channels are obstructed. On the average, the monthly temperature of the area ranges between 24.7^{o}c and 28^{o}c, with an annual average temperature of 26.8^{o}c. The

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relative humidity is also generally high throughout the year varying between 65% and 95% at mid-day and night respectively. The predominant wind direction in the municipality is usually from "West South West (WSW) to North North East (NNE): (LADMA, 2014:27).

3.2.2.4 Vegetation

The vegetation of the Municipality consists of dense clusters of small trees, shrubs and grasses, which grow to an average height of six metres. The grasses are a mixture of species found in the undergrowth of forests. They are short and rarely grow beyond one metre. Ground herbs are found on the edge of the shrub. They include species, which normally flourish after fire. Mangroves, comprising of two dominant species, are found in the tidal zone of all estuaries sand lagoons. Salt tolerant grass species cover substantial low-lying areas surrounding the lagoons. These grasslands have an important primary production role in providing nutrients for prawns and juvenile fish in the lagoon systems (LADMA, 2014)

3.2.2.5 Drainage

The drainage catchment area for the municipality extends from the eastern boundary of the Nyanyanu catchment on the west of Greater Accra Regional boundary through to the Kpeshie Lagoon (LADMA, 2014). Some major natural drains in the area include Kpeshie lagoon, the African Lake and the Kordzor stream (LADMA, 2014).

3.2.3 Demographic Characteristics

According to the 2010 Population and Housing Studies, the population of the Municipality as at 2010 was 183,528, growing at 3.17 censual rate (Ghana Statistical Service, 2014). Based on this, the 2017 population of the municipality is projected around 228,005 (LADMA, 2014) with females and males constituting 52.7 percent and 47.3 percent respectively (Ghana Statistical

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Service, 2014). By age distribution, the municipality has predominantly youthful population with those within the 15-34 age brackets constituting about 40% of the population followed by those from 0-14 years who also constitute 29% of the total population. Those in the 35-59 age brackets constitute 24% and those 60 years and above constitute just about 7% of the total population. Also the age dependency ratio of the municipality is around 50.1% (Ghana Statistical Service, 2014).

3.2.4 Housing and residency

It is estimated that, there are 19,174 houses and 51,154 households in the La Dade-Kotopon municipality with an average household size of about 4 (3.6). About 37% houses in the municipality are owned by household member(s), 16.7% owned by government and the rest (46.3%) owned by other private individuals and estate developers (Ghana Statistical Service, 2014). In terms of residency, the communities in the municipality are put into five categories (Class A-D and the Special zones) depending on the settlement and functional characteristics of the communities (LADMA, 2014). The 'Class A' communities, located in North Labone Estates, Airport residential, Cantonments and East Cantonments have very high rising and expensive buildings with highly structured layouts, and are usually occupied by first class and diplomatic personalities in the country. The 'Class B' communities are emerging communities – even though they have expensive buildings, they have not fully developed and are usually occupied by the middle class people in the society. Besides the property rate generated there are not as high as the 'class A' communities. This includes communities such as Labone Estate and Tse-Addo. The 'Class C' communities which are located in Ako-Adjei, Nyaniba Estates and South La Estates are, even though developed their buildings are not as expensive as those in Class A and Class B, and the property rates are relatively lower. The 'Class D' communities are the low

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income communities in the municipality. They are basically the pure indigenous Ga communities characterized by relatively inexpensive buildings, congested settlements with poor layouts, majority of which have or are developing into slums. The Class D communities are located in Adiembra, Otwe, Abafum, Kowe/Abese, Adebetor, Kaklamadu, Lakpanaa and Apapaa. The 'Special Zones' on the other hand are the places marked as the security zones in the municipality. These include Burma Camp, Police Headquarters and Prisons Headquarters (LADMA, 2014).

3.2.5 Sanitation and Environmental Issues

Issues on the environment and sanitation are very critical in the municipality. The exponential growth in the population of the municipality resulting from rural-urban migration, coupled with the ever sprawling settlement in the municipality has created lots of environmental issues that need critical attention. For instance, currently about 2,752 tonnes of solid waste are generated in the Municipality monthly. Out of this, the Assembly is able to collect an average of 58% monthly through the services of private waste collectors such as Asadu Royal Deed and Waste Management Limited, Platinum Municipal Services, Rapid Waste Limited and Zoomlion Company LTD, leaving a backlog of 42% in the street (LADMA, 2016). Also the Kpeshie lagoon which serves as buffer for receiving volumes of water carried by the drains in the municipality has become dysfunctional in recent times due to the high volumes of solid waste dumped into it (LADMA, 2014).

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3.3 Background Characteristics of Study Communities

3.3.1 Kenan Factory

Kenan factory is a community in the Adiembra electoral area in La Dade-Kotopon Municipality. The community is an indigenous settlement with an estimated population of 486[7] of which about 95% of residents are native Gas. A field observation carried out in the community and interviews with some community members and the Assembly Member revealed that the community is densely populated with predominantly low income dwellers, and significant proportion of the area developing into slums. Again, the entire community is built on a relatively low land and the drainage system is poorly designed. Sanitation is also a major issue in the community as significant proportion of domestic solid waste are not efficiently collected and disposed. Hence solid waste are seen scattered or form heaps in some quarters of the community some of which find their ways into the already defective drains. For this and some other reasons, the community is highly susceptible to floods even after moderate rainfall.

3.3.2 Pentecost Down

Pentecost Down is a community in the New Lakpanaa electoral area with an estimated population of 474. Like Kenan Factory, the community is purely indigenous Ga community with predominantly low income dwellers. A field observation of the area and interviews with Zonal NADMO officials in the area revealed that, the land is highly impervious – it is wet throughout the year as water naturally springs out of the ground even when there is no rain. Besides, the community has very close settlement, poor layout and virtually no major drains to carry runoff

[7] Calculation was done by multiplying the total households in the community as estimated by the NADMO Directorate of the Municipality by the average household size of the community. Similar calculation was done to estimate the population of all the other communities

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water in the event of rainfall. As result of these, the community gets flooded frequently whenever it rains heavily especially during the raining season.

3.3.3 Adzeman

Adzeman is also one of the indigenous Ga communities located in the Kowe/Abese/Abafum electoral area in the La Dade-Kotopon Municipality with an estimated population of 530. The community is a relatively low income community that lies in the same area with Pentecost down community and about 95% of its residents are native Gas who inherited the place through family lineage. The community which traditional name was revealed by the Zonal NADMO coordinator during a field observation of the area as "Adzeman Mootor" [adʒɪmaŋ mɔɔtɔ] meaning "muddy area" is highly predisposed to floods. Like Pentecost Down, the land is highly impervious; it is wet throughout the year with water springing out of the ground even when it has not rained for weeks. Beside the impervious soil, the settlement structure in the community is very close with poor layout. An observation of the drainage system also revealed that the community is highly deficient with drains, and these expose it to floods whenever there is heavy rainfall.

3.3.4 Fisheries

Fisheries is also a native Ga community that lies at the coast of the municipality in the New Kaajaanor electoral area with an estimated population of 420 who are predominantly low income earners. Even though the community is relatively dry as compared to the other study communities, the relatively slopy land topography coupled with deficient drainage system, congested settlement, poor layout and defective solid waste disposal exposes the area to severe flash flood during heavy rainfall.

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3.3.5 Tse-Addo Down

Tse-Addo Down is a community in Tse-Addo/Mantease electoral area with an estimated population of 264. As the name suggests, the community is part of the entire Tse-Addo Township and lies at the southern part of the community. The community is an emerging community with modern settlement structures occupied by predominantly middle income people. A revelation made by the Zonal NADMO Coordinator during a field observation and primarily interactions with major stakeholders in the area indicated that, the community was not previously used for residential purpose as it served as buffer where runoff water generated from the communities in the North were deposited during heavy rains. However due to recent scarcity of land in Accra, the whole area has been sold to people for residential purposes. It was also revealed during the field observation that, putting up structures on reclaimed land was the common practice in the community. Again despite the fact that the community lies adjacent to the Kordjor Stream, there are currently no major drains within the community to carry runoff water into the stream, hence making the community very vulnerable to floods.

Figure 3.2 shows the map of the electoral areas of the La Dade-Kotopon Municipality. Similarly, Figure 3.3 shows the map of the flood-prone communities in the Municipality

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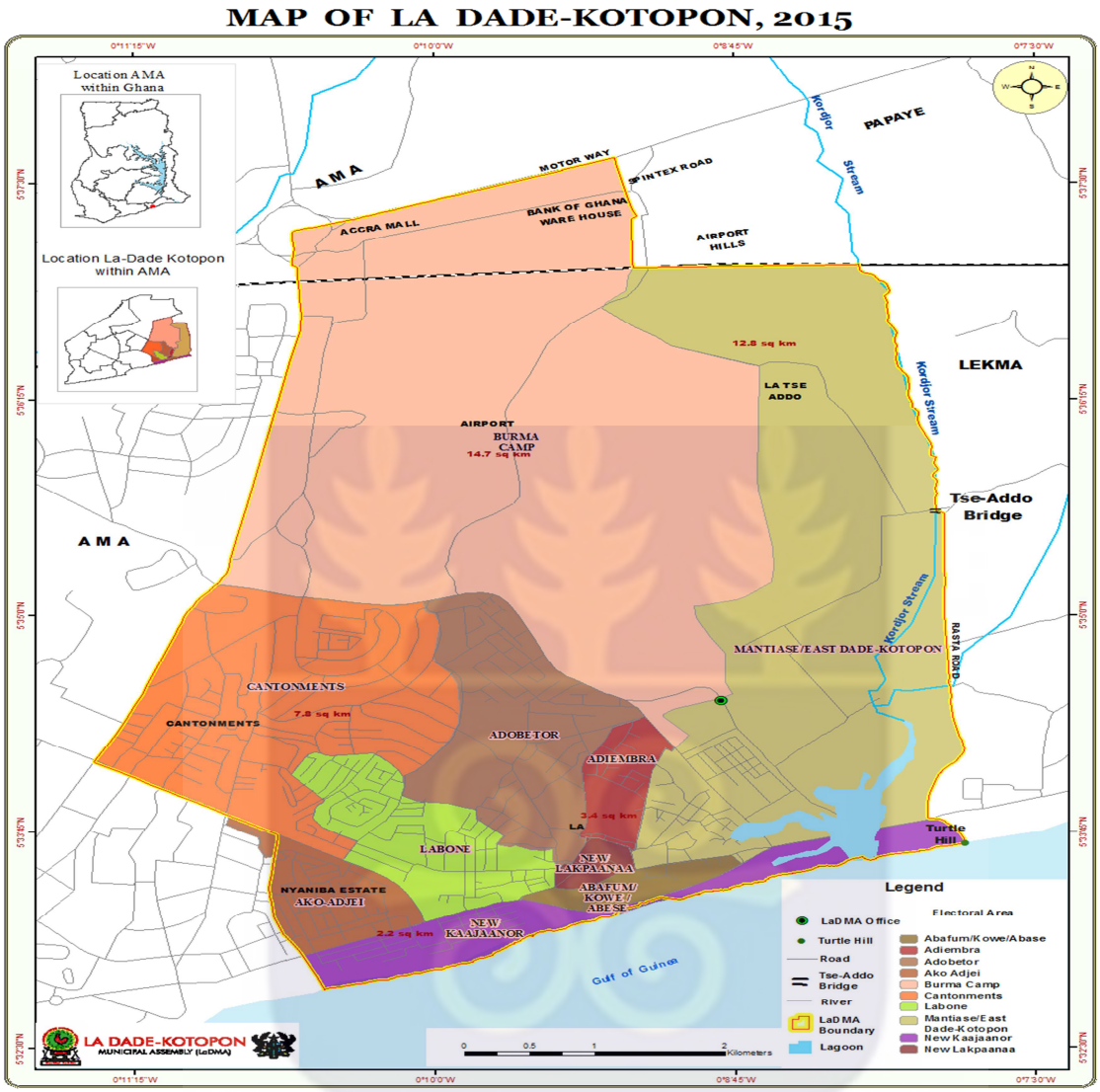
Fig 3.2: The Electoral Area Map of La Dade-Kotopon



Source: LADMA Planning Coordinating Unit (2014)

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Fig 3.3: The Flood Prone Areas Map of La-Dade Kotopon

East Dade-Kotopon Electoral Area

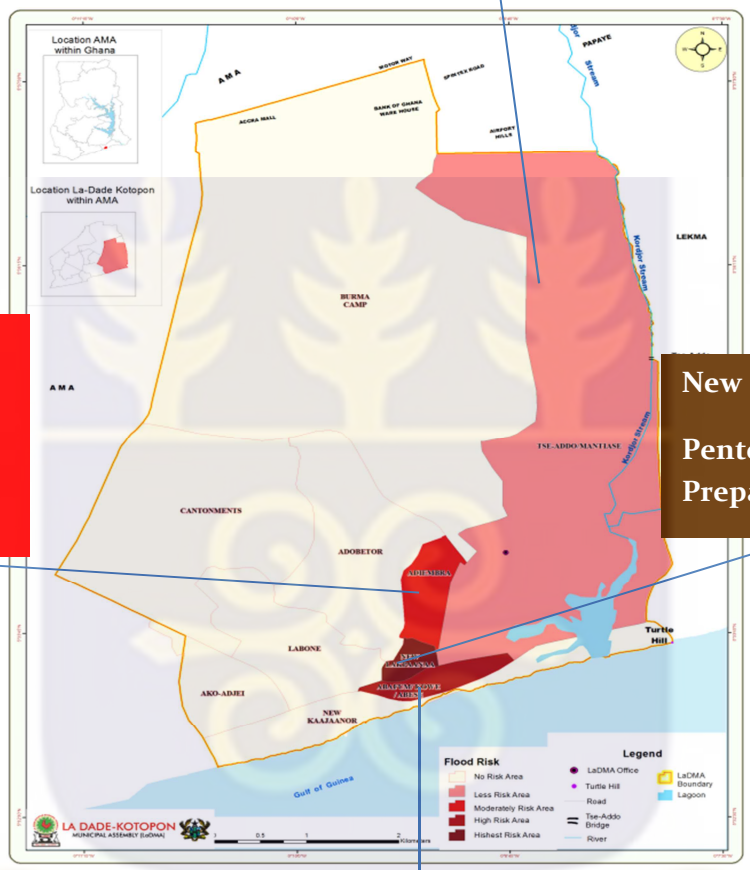
Houses on the both sides of the Korjor Stream and around the ICGC behind the Redeemed Church

Adiembra Electoral Area

Affected areas include Havanna Park, Mento Soap Factory, La Koo, Kenan Factory

New Lakpanaa Electoral Area

Pentecost down, New Life Preparatory School, Salt Park



Kowe/Abese/Abafum Electoral Area

La Beach Road, Cat Bar to Regimanuel, Adzeman, Nyantrabishie, Nii Kwakranya Crescent

Source: LADMA Planning Coordinating Unit (2014)

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3.4 Research Design

Research design in general, provides the framework within which the entire study is conceived and carried out. According to Babbie (2005), research design gives a brief on how the entire work will be carried out. This study was both exploratory and descriptive; the study explored in various dimensions, the phenomenon of floods in flood-prone communities in La Dade Kotopon Municipality. It sought to explore the various adaptive and mitigation practices households, community and other stakeholders adopt in managing floods in the study communities. To achieve this, data from both primary and secondary sources were used. The primary data was obtained using a mixture of quantitative and qualitative data collection instruments. The mixed method was seen appropriate because it gave room for the researcher to explore both the breadth and depth of the phenomenon under study. Lisle (2011) argues that, the mixed method approach helps to tap the strengths of both quantitative and qualitative approaches in a single study, and also provide an avenue to fill in the gap that would have been created due to the weaknesses inherent in using a single approach. He therefore argues that data obtained using mixed method is more credible. However, in an argument raised by Babbie (2005), it is more difficult to analyze data using a combination of both quantitative and qualitative data than analyzing data from a single method. Contrary to his earlier argument, Lisle (2011) acknowledges that the credibility of data is not only measured by the research method used, but it is based on every aspect of the research including sample selection procedure.

Whereas the quantitative data was used to provide factual evidence on the state of flooding and flood adaptation and mitigation measures by local community members, the qualitative data explored deep into the complex nature of the phenomenon from key informants and relevant opinion leaders in the community. The quantitative data obtained was then analyzed using

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various descriptive statistical techniques and was complemented by the qualitative data to give deeper understanding to the phenomenon of study.

3.5 Sources of Data

Data from both primary and secondary sources were used for the study. The secondary data were obtained from the relevant literature reviewed, and some from documents retrieved from various institutions in the municipality whose activities are relevant to the subject of the study. The primary data on the other hand were obtained from household surveys, in-depth interviews of key personalities in the communities, key informant interviews and from field observation.

3.6 Primary data Collection Methods

The primary data for the research were collected through combination of quantitative and qualitative data collection techniques including household survey, in-depth interviews of key community members, key informant interviews and field observation.

3.6.1 Method of Quantitative Data Collection

Quantitative data were collected from respondents from 191 households from the study communities in the municipality using structured questionnaires with mixture of close-ended and open-ended questions, which were administered by the researcher through face to face interview. The questions were organized under eleven sections labeled from A to K. Section A captured the socio-demographic characteristics of respondents and their respective households; While Section B also looked at the occurrence of floods in the study community. Section C and D covered the causes of floods and effects of floods in the study communities respectively. Section E and F also focused on the various household adaptation and mitigation strategies for floods

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respectively, whereas Section G and H explored community adaptation and mitigation strategies respectively. Also Sections I, J, K and M explored the institutional adaptation measures, institutional mitigation measures, household adaptation constraints and household mitigation constraints in that respect.

3.6.2 Methods of Qualitative Data Collection

The qualitative data were collected through in-depth interviews and key informant interviews and field observations. These were used to complement the data from the household survey. For the in-depth interviews, the Assembly Member as well as one community member from each of the five selected communities were interviewed to understand the strategies their communities have adopted in flood adaptation and mitigation. The assumption for selecting the Assembly Members was that, their close contact with the community members and their special role in their respective communities make them the first point of call in any flood incidence, hence endowing them with rich knowledge and experience on how their communities deal with floods.

Key informant interviews were held for six key officers in the municipality whose activities are related to the subject of study. The key informants interviewed included Municipal NADMO Coordinator, Municipal head of Town and Country Planning Unit, the Municipal Finance Officer, the Municipal Planning Officer, the Municipal Engineering Officer and the Chairperson of Works and Disaster Sub-committee of the Assembly. The reason for the key informant interviews was to assess broadly how the assembly through its institutions is dealing with flood disaster issues in the municipality. It was also to assess the coordination among the various departments of the assembly in handling flood issues.

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3.6.3 Field Observation

To enhance familiarization, the researcher undertook field observation of the study communities prior to the administration of the household surveys, key informant and in-depth interviews to take stock of the characteristics of the study communities. Issues observed included the nature of their drainage systems, settlement conditions, land topography, environment conditions (including sanitation and waste disposal), and structural and non-structural measures activated in the communities to manage floods. This technique was very useful for the researcher in designing the research instruments and also in capturing certain data that could not appear in household survey and the interviews

3.7 Target Population

The target populations for this study were households in the flood-prone communities in LaDMA. A list obtained from the Municipal NADMO coordinating directorate revealed that there were ten main flood-prone communities in LADMA with 367 total households who are exposed to floods. The communities are Fisheries, Kakramadu, Nii Kwankranya Cresent, Adzeman, Nyantrabishie, Kenan factory, El-Yameh, Pentecost Down, Tse-Addo Down (communities around Korjor Stream and New life (Municipal NADMO Directorate-LADMA, 2017). The reason for limiting the target population to households exposed to floods is in line with the focus of the study as their consistent exposure to floods will make them more conscious about it than their neighbours who are not directly exposed to it. Besides, Abeka (2014) study reveals that, in the events of floods, households are more likely to adopt a collective coping strategy than individual members will do separately. In line with this, this study used households as the unit of analysis, with the argument that floods affect household members collectively and so they are expected to come together with a collective strategy to deal with the situation.

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3.8 Sample Size Determination

The sample size for the study was determined using Yamane's (1967) formula which states that

$n = N/ 1 + N (e^2)$

Where:

n = sample size

N = population size (367)

e = the level of precision (0.05)

Therefore using the formula, $n = 367/ 1+ 367 (0.05^2)$

$n = 191$

The sample for the study was therefore respondents from 191 households selected from the five sampled study communities.

3.9 Sample Selection Procedure

The sample for this study was selected through multistage sampling technique. This technique involves using about two or more sampling techniques in order to obtain your sample from the population. According to Babbie (2005), this technique is used when it is difficult to derive your sample from the population with only one single method. The sampling procedure is divided into various levels, and at each level a relevant technique is used till the sample is finally obtained. In this study, five communities were sampled out of the ten flood-prone communities within the municipality through simple random sampling using lottery method. The number of households sampled for the study as displayed in Table 3.1, was proportionally distributed among the five

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selected communities according to the number of the households exposed to floods in each community. The households for each of the selected communities were then selected purposively based on the availability and willingness of household members to participate in the study. For each household, one member, preferably, the household head was included in the study and in the absence of the substantive household head, the next available adult in charge of the household at the time of the visit was selected as a substitute.

Table 3.1: Sample Determination for Selected Communities

	Community	Households exposed to Floods	Household Sampled for Study
1	Pentecost Down	79	47
2	Kenan Factory	81	49
3	Adzeman	80	48
4	Fisheries	35	21
5	Tse-Addo	44	26
	Total	**319**	**191**

Source: Author's own Calculation

3.10 Data Analysis

The quantitative data obtained from the household survey were coded and analyzed using STATA statistical analysis software. These were analyzed using descriptive statistics such as mean, mode, simple percentages among others and were displayed in tables, bar charts, pie charts and histograms to cover the objectives of the study relating to households. These were then supported with the qualitative data obtained from the in-depth and key informant interviews to help understand how floods unfold in the study communities, and how households and other stakeholders through their individual and collective efforts manage floods in the study communities as well as the challenges they encounter. Table 3.2 shows the linkages between the objectives of the study, methods of data collection and analysis.

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Table 3.2 Linkages between research objectives, methods of data collection and analysis

OBJECTIVES	RESEARCH QUESTIONS	TYPE OF DATA	SAMPLING METHOD	METHOD OF DATA COLLECTION	UNIT OF DATA COLLECTION	ANALYTICAL TECHNIQUE
To examine the causes of floods in the flood-prone communities in La Dade-Kotopon Municipality	What are the major causes of floods in the study communities?	Quantitative and Qualitative	Multistage Sampling	Field Observation; Survey Questionnaire; In-depth Interviews and Key Informant Interviews	Households heads; Community members; assembly men; HODs of NADMO, TCPD,	Descriptive Statistics Supported with thematic analysis
To assess the effects of floods in the flood-prone communities in La Dade-Kotopon Municipality	What are the defects of floods on households in the study communities?	Quantitative and Qualitative	Multistage Sampling	Survey Questionnaire; In-depth Interviews and Key Informant Interviews	Households heads; Assembly men; Community members, Chairman for WDSC and HODs for NADMO, TCPD, Planning, Finance	Descriptive Statistics supported with thematic analysis
To assess the adaptation and mitigation measures put in place by households and other stakeholders in LaDMA to address floods	What adaption and mitigation measures have been put in place to address flood disaster?	Quantitative and Qualitative	Multistage Sampling	Survey Questionnaire; In-depth Interviews and Key Informant Interviews	Households heads; Assembly men; Community members, Chairman for WDSC and HODs for NADMO, TCPD, Planning, Finance	Descriptive Statistics Supported with thematic analysis
To assess the constraints in the implementation and mitigation measures	What Constraints do stakeholders face in implementing the adaptation and mitigation measures?	Quantitative and Qualitative	Multistage Sampling	Survey Questionnaire; In-depth Interviews and Key Informant Interviews	Households heads; Assembly men; Community members, Chairman for WDSC and HODs for NADMO, TCPD, Planning, Finance	Descriptive Statistics Supported with thematic analysis

Source: Author's own construct

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3.11 Challenges in the Field and how they were overcome

The researcher was confronted with couple of challenges that needed immediate attention. Notable among them was the problem of language barrier which made communication with community members quite difficult. To address this, the research employed the services of some assistants who could understand and speak the native language to aid in the data collection. Moreover, English language was used as a medium of communication for respondents who could understand and speak it fluently.

Another major challenge that confronted the researcher was how to reach the officials of the municipality who were targeted for the key informant interviews. The initial plan was to conduct face to face interviews with them after booking appointment. However, it became very difficult for the researcher to meet all the target officials face to face; therefore alternative approach of interviewing them through phone call was adopted to elicit the needed data.

3.12 Conclusion

This chapter focused on the Profile of the study area and the research methodology. Diverse issues such as the location, size, political and administrative setup of the municipality were captured under the profile of the study area. Other issues discussed under the profile included the physical environment of the municipality where issues such as the geology, soil and climate were all discussed. Again the demographic characteristics of the study area; housing and residency as well as sanitation and environmental issues were all considered. Under the methodology, issues such as the study design; sources of data, the instruments for data collection; sample size determination, sample selection procedure as well as the procedure for data analysis were all discussed.

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CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter focuses on the analysis and discussion of the data obtained from the field. Various thematic issues such as the socio-demographic characteristics of respondents and their households; occurrence of floods in the study communities; causes of floods and the effects of floods on the households in the study communities will be analyzed. Other issues the chapter focuses on include households flood adaptation measures; households flood mitigation measures; community flood adaptation measures, community flood mitigation measures; institutional flood adaptation measures and institutional flood mitigation measures.

4.2 Background Characteristics of Respondents

This study focused on the flood-prone communities in La Dade-Kotopon Municipality. A total of 191 respondents from the households sampled in the five selected flood-prone communities were interviewed to elicit their views on floods; its causes; effects on their households, and also to understand the adaptation and mitigation measures activated by households and other stakeholders in the study communities to address floods. Table 4.1 reveals that, out of 191 respondents who took part in the study, 48 respondents were from Adzeman, 47 from Pentecost Down, while 49, 26 and 21 were from Kenan Factory, Tse-Addo and Fisheries respectively. This distribution was done proportionately in accordance with the number of households exposed to floods in each of the selected communities. In addition, the table reveals that 54% of the respondents were males and 46% were females; an indication of a fair representation of both sexes which helps to reduce biases.

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By age distribution, there were variations in the ages of the respondents ranging from 20-29 years age brackets to those who were 60 years and above. Table 4.1 reveals that, respondents whose ages fell within 40-49 years were the most represented, constituting about 31%, followed by those within 30-39 years who constituted 22% of the total respondents. Also, 21%, 15% and 11% of the respondents had their ages within 50-59, 60+ and 20-29 years respectively. This shows that all the people who participated in the study were adults and so were matured enough to have fair idea about the experience of their households in relation to floods.

In relation to educational level of respondents, as displayed in Table 4.1, beside 12% of the respondents who have not received any formal education, all the others have received formal education ranging from primary level to tertiary. Majority of the respondents, constituting 38% have received formal education up to the Senior High School (SHS) level, followed by 26% who have received formal education up to the Junior High School (JHS) level. Also 18% of the respondents have received tertiary education and 6% only completed Primary School. This variation in educational levels will help to understand the dynamics in people's perception about floods and flood management.

In terms of religion, majority of the respondents, constituting 84% were Christians, as compared to 15% and 1% who were Muslims and African Traditional Religion believers respectively.

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Table 4.1: Socio-Demographic characteristics of respondents

Variable	Frequency	Percentage
Community		
Adzeman	48	25.1
Pentecost Down	47	24.6
Kenan Factory	49	25.7
Tse-Addo	26	13.6
Fisheries	21	11.0
Sex of Respondent		
Male	104	54.4
Female	87	45.6
Age of Respondent		
20-29	21	11.0
30-39	42	22.0
40-49	59	30.9
50-59	41	21.4
60+	28	14.7
Educational Level of Respondent		
Uneducated	23	12.0
Primary	12	6.3
JHS	49	25.7
SHS	72	37.7
Tertiary	35	18.3
Religion of Respondent		
Christian	161	84.2
Muslim	28	14.7
ATR	2	1.1

Source: Field Survey June, 2017

4.3 Socio-Demographic Characteristics of Households

An analysis of the demographic characteristics of the 191 households who participated in the study reveals male-headed households' dominance in the study communities. As displayed in Table 4.2, 72% of the households have male heads and only 28% have female heads. In terms of highest education obtained in the households, a greater percentage of households, constituting 52% have at least one member who has completed tertiary education; followed by 36% who have at least a member who has completed Senior High School (SHS) level. 7% also have

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members have completed Junior High School; 2% have members who have completed Primary school while 3% did not have any member who has completed any level of formal education. Table 4.2 further reveals that majority (81%) of the households who participated in the study live in Sandcrete building; whereas 10%, 6% and 3% live in Brick, Mud and Wooden buildings respectively.

Table 4.2: Socio-Demographic Characteristics Households

Variable	Frequency	Percentage
Sex of Household Head		
Male	137	71.7
Female	54	28.3
Highest Level of Education Obtained in the Household		
None	6	3.1
Primary	3	1.6
JHS	14	7.3
SHS	68	35.6
Tertiary	100	52.4
Nature of Building		
Sandcrete Building	154	80.7
Brick Building	20	10.4
Mud House	5	2.6
Wooden Building	12	6.3

Source: Field Survey June, 2017

An analysis of the occupation of the household heads also shows that majority of them are engaged in the informal sector. As displayed in table 4.3, 26% of household heads are artisans; 24% are traders; 13% are drivers; 2% caterers; 2% fishermen and 2% farmers. Those engaged in the formal sector constitute 7% civil servants; 5% private sector professional workers (including bankers, accountants and engineers); 4% public servants and 2% security personnel (including police and military officers). Also 7% of household heads are pensioners and 7% are not working.

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Table 4.3: Occupation of Household Head

Variable	Frequency	Percentage
Artisan	50	26.2
Caterer	4	2.1
Civil Servant	14	7.3
Driver	24	12.6
Farmer	3	1.6
Fisherman	4	2.1
Pensioneer	13	6.8
Private Professional	10	5.2
Public Servant	7	3.7
Security Person	3	1.6
Trader	46	24.0
Not Working	13	6.8
Total	191	100

Source: Field Survey June, 2017

Considering income levels, Table 4.4 reveals that, about 71% of the households that participated in the study have their household average income falling within the lowest two income categories. About 14% have average household income between GH¢ 1,100-1,500 and about 8% between GH¢1,600-2,000. Only 7% of the households have average income above GH¢2,000. This gives a reflection that communities under study have predominantly low income dwellers. Comparing average household income by communities, table 4.4 further reveals that, with the exception of Tse-Addo which has about 62% of households whose average income fall in the highest three income categories, households in all the other communities have average household income within the lowest two income categories. Pentecost Down for example has as many as 94% of the households in the last two categories and Adzeman having 77% in the same categories. An overview of the average household income by communities confirms the categorization undertaken by the Planning unit of the municipality that, with the exception of Tse-Addo that falls within the class 'B' category, all the other communities fall within the class 'D' communities (LADMA, 2014).

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Table 4.4: Household Average Monthly Income by Community

Community	Household Average Monthly Income (%) [GH₵]					Total (%)
	100-500	600-1000	1100-1500	1600-2000	Above 2000	
Adzeman	12.5	64.6	12.5	6.3	4.2	100
Pentecost Down	49.0	44.7	4.2	2.1	0	100
Kenan Factory	32.7	30.6	14.3	10.2	12.2	100
Tse-Addo	11.6	26.9	34.6	15.4	11.5	100
Fisheries	33.3	33.3	9.5	9.5	14.4	100
All	28.8	42.4	13.6	7.9	7.3	100

Source: Field Survey June, 2017

Tables 4.5; 4.6; 4.7 and 4.8 display the average household size; number of years households have lived in the communities; number of years they have lived in the building and the residential status of households respectively. Table 4.5 reveals that among the 191 households that participated in the study, their household sizes range from a minimum of 2 to a maximum of 10 and an average household size of 6 people. Also the number of years households have lived in their respective communities varies, ranging from a minimum of 2 years and a maximum of 80 years with an average of 29 years. This shows that all the households have lived in the study communities for substantial number of years to have experience and necessary information about the flood situation in their communities. From Table 4.7, the number of years households have lived in their current building in the study communities varies ranging from a minimum of 2 years to a maximum of 70 years with an average of 20 years. This also confirms that all the households who participated in the study have spent substantial number of years in their respective buildings to make them qualify to answer questions on the subject of the study. An analysis of the residential status of households as displayed in Table 4.8 also shows that about 40% of the households that participated in the study are occupying their own buildings, whereas 35% are relatives to the owners of the building and 25% are tenants. This can have influence on households' choice of particular adaptation and mitigation measures.

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Table 4.5: Household Size

Variable	Observation	Mean	Std. Dev.	Min	Max
Household Size	191	5.926702	1.848148	2	10

Source: Field Survey June, 2017

Table 4.6: Number of Years Household has lived in the Community

Community	Observation	Mean	Std. Dev.	Min	Max
Adzeman	48	41.85417	17.00812	5	80
Pentecost Down	47	25.97872	14.77879	5	61
Kenan Factory	49	27.61224	17.95575	2	70
Tse-Addo	26	8.807692	2.668621	3	15
Fisheries	21	36.66667	18.09788	7	70
All Communities	191	29.22513	18.65579	2	80

Source: Field Survey June, 2017

Table 4.7: Number of Years Household has lived in the Building

Community	Observation	Mean	Std. Dev.	Min	Max
Adzeman	48	27.47917	15.85438	2	70
Pentecost Down	47	19.46809	12.85682	2	45
Kenan Factory	49	17.26531	14.9691	2	66
Tse-Addo	26	8.038462	2.253544	3	12
Fisheries	21	25.85714	14.31882	4	45
All Communities	191	20.06283	14.85106	2	70

Source: Field Survey June, 2017

Table 4.8: Residential Status of Households

Residential Status	Frequency	Percentage
Owner of Building	77	40.3
Tenant	66	34.6
Relative to Owner	48	25.1
Total	191	100

Source: Field Survey June, 2017

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4.4 Occurrence of Floods in the Study Communities

The research sought to understand the flood situation in the study community in terms of frequency of its occurrence. Table 4.9 shows that out of the 191 households that responded to the questionnaires, about 98% indicated that their households have ever experienced floods in their current respective communities, as against 2% who indicated they have not experienced floods. Further analysis indicates that, 53% of those whose households have ever been flooded have experienced it eight times and above ever since they started living in their current communities; 12% have experienced it thrice; 11% have experienced it four times; 10% seven times, in that order through to 2% who have experienced it only once in their current communities. In relation to the last time households flooded, an overwhelming 85% of respondents indicated that they experienced floods within the last six months to the period of interview (ie. between 20th June to 30th June,2017), followed by 7% who experienced it a year ago, and only 1% experienced it more than three years ago. These findings give some revelations that, floods occur very frequently in the study communities, which confirms their categorization by the municipality authority as flood-prone communities (LADMA, 2014).

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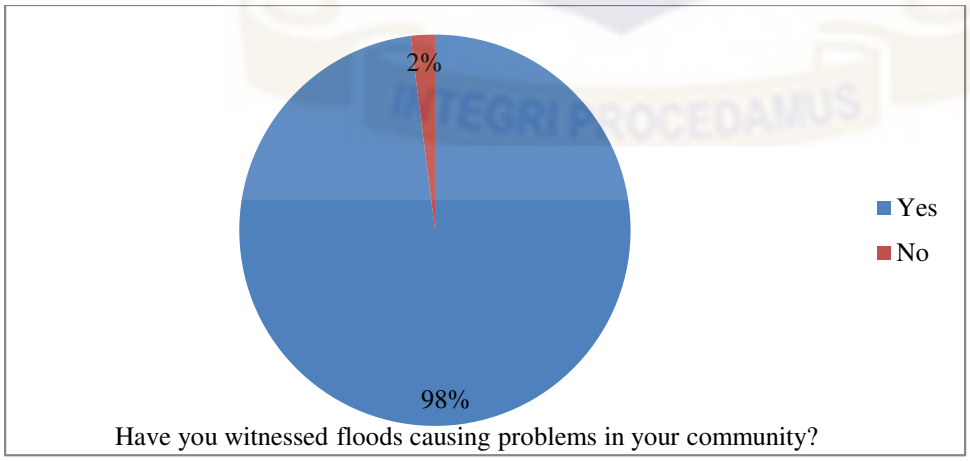
Table 4.9: Household's Experience with Floods

Variable	Frequency	Percentage
House hold ever flooded?		
Yes	187	97.9
No	4	2.1
Number of Times House Hold has flooded		
Once	3	1.6
Twice	13	7.0
Thrice	22	11.8
Four times	20	10.7
Five times	7	3.7
Six times	3	1.6
Seven times	19	10.1
Eight times and Above	100	53.5
Last time Household flooded		
Between 1-6 Months ago	159	85.0
Between 7-11 Months ago	5	2.7
One year ago	13	7.0
Two years ago	7	3.7
Three years ago	1	0.5
More than three years ago	2	1.1

Source: Field Survey June, 2017

In assessing the trends of occurrence of floods in the communities, Figure 4.1 reveals that, 98% of respondents indicated they have witnessed floods destroying properties and causing problems in their communities as against 2% said they have not witnessed that.

Fig 4.1: Communities' exposure to floods



Source: Household Survey June, 2017

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Table 4.10: Trends of Floods in the Communities from 2013-2016

Adzeman:				
	Year			
Number of Times Community Flooded	**2016 (%)**	**2015 (%)**	**2014 (%)**	**2013 (%)**
Once	0	0	0	2.1
Twice	8.3	14.6	10.4	10.4
Thrice	10.4	10.4	25.0	25
Four Times	6.3	14.6	14.6	18.8
Five Times	8.3	14.6	16.7	8.3
Six Times	**56.3**	**39.6**	**25.0**	**29.2**
Cannot Recall	10.4	6.2	8.3	6.2
Pentecost Down:				
Number of Times Community Flooded	**2016 (%)**	**2015 (%)**	**2014 (%)**	**2013 (%)**
Once	2.1	0	0	0
Twice	6.4	4.3	2.1	10.6
Thrice	25.3	14.9	23.4	23.4
Four Times	14.9	**31.9**	21.3	**25.5**
Five Times	14.9	12.8	19.2	12.8
Six Times and Above	**34.0**	29.8	**27.7**	19.2
Cannot Recall	2.2	6.3	6.3	8.5
Kenan Factory:				
Number of Times Community Flooded	**2016 (%)**	**2015 (%)**	**2014 (%)**	**2013 (%)**
Once	6.5	15.2	17.4	6.7
Twice	**34.8**	26.1	**37.0**	**42.2**
Thrice	30.4	**30.4**	8.7	26.7
Four Times	4.4	10.9	6.5	2.2
Five Times	2.2	0	0	4.4
Six Times and Above	15.2	15.2	2.2	0
Cannot Recall	6.5	2.2	28.2	17.8
Tse-Addo				
Number of Times Community Flooded	**2016 (%)**	**2015 (%)**	**2014 (%)**	**2013 (%)**
Once	3.9	3.9	19.2	7.7
Twice	**50**	**38.5**	23.1	**50**
Thrice	19.2	34.6	**38.5**	7.7
Four Times	15.4	11.5	15.4	23.1
Five Times	7.7	7.7	0	3.9
Six Times and Above	0	0	0	0
Cannot Recall	3.8	3.8	3.8	7.6
Fisheries				
Number of Times Community Flooded	**2016 (%)**	**2015 (%)**	**2014 (%)**	**2013 (%)**
Once	4.8	0	4.8	9.5
Twice	4.9	14.3	23.8	14.3
Thrice	9.5	14.3	9.5	18.0
Four Times	19.1	9.5	19.1	14.3
Five Times	4.8	14.3	14.3	**20.1**
Six Times	**57.1**	**47.6**	**23.8**	14.3
Cannot Recall	0	0	4.7	9.5

Source: Field Survey June, 2017

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Community by community analysis of the trends of floods from 2013-2016 as displayed in Table 4.10 also reveals that all the communities have had varying frequencies of floods. With the exception of Tse-Addo and Kenan Factory where majority of the respondent said they witnessed floods in their communities between two times and three times annually, in all the other communities majority of the respondents indicated that floods occurred in their communities at least four times each year between 2013 and 2016. These give further confirmation that floods are very frequent in the study communities.

In assessing the months within which floods usually occurred in the communities. Fig 4.2 shows that, majority of respondents constituting 67% indicated floods usually occurred within the months June and July, whereas 14% said floods occurred between June and August. 13% and 4% indicated floods occurred within May to July and May to August respectively, and only 2% said floods occurred between March and July. This result shows that, despite the slight variations, there is a trend of floods occurring between the months May and August which are also the raining seasons in most parts of the country. This trend gives some level of predictability which is important for households and other stake-holders to initiate the relevant adaptation and mitigation measures in anticipation of the season. A statement by the Municipal NADMO coordinator confirmed this:

> "*knowing that the rains usually begin in May, and that is when the communities start having floods, we usually do community inspections and community sensitization programs between February and March each year and give our report to the assembly and our regional office for necessary actions to be taken…….we also give early warning signals to people who we suspect will be in danger of floods during such visits"* (Key Informant Interview, 27th June 2017).

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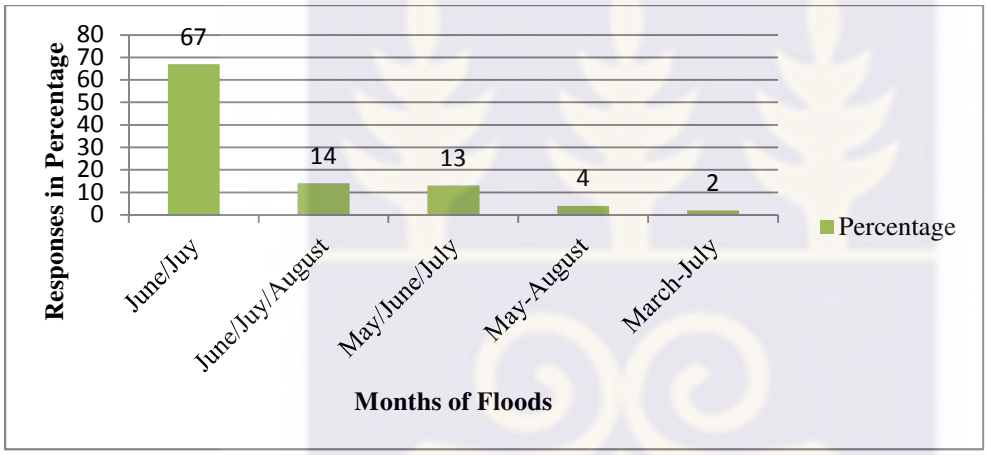
A community member also indicated that his household usually installs their adaptation measures during this period in preparation for the rains.

> *"We make sure we buy enough sand bags by April and keep them in wait for the rains…..and we clear the gutters around our building also"* (Personal In-depth Interview, 21st June 2017)

Fig 4.2: Respondents' views on Months Floods Occur



Source: Field Survey June, 2017

Regarding the type of floods the communities usually experience, the results as displayed by fig 4.3 shows that, with the exception of Fisheries that experiences flash floods, all the other communities mostly experience inland or areal floods. This implies that flood waters are likely to stagnate for a very long time in those communities before draining. The Assembly man for Adiembra electoral area intimated that,

> "*it takes close to six months after the rains have stopped before Kenan Factory gets dry"*(Personal In-depth Interview, 21st June 2016).

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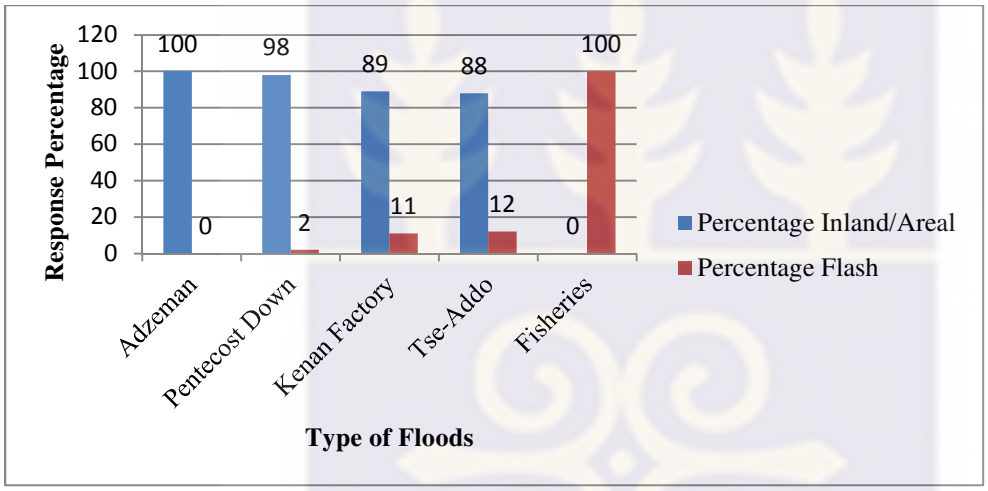
For Adzeman and Pentecost Down, the NADMO coordinator stated that the water never drains completely throughout the year. In his words during the field observation:

> "*water springs out of the land naturally, so this place never gets dry, we will get to some places you will even see fingerings swimming in the water around people's buildings"*(Key Informant Interview, 19th April 2017)

Fig 4.3: Views of Respondents on the Type of Floods



Source: Field Survey June, 2017

Plate 4.1 for example displays pictures of stagnant water at the forecourts of some buildings at Pentecost down.

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Plate 4.1: Forcourts of some Buildings in Pentecost Down

Source: Field Observation April 2017

4.5 Causes of Floods at the Study Communities

The research further made enquiries into the main factors contributing to floods in the study communities.The results as displayed in Table 4.11 show that, issues concerning the drainage system dominated with overwhelming majority of 98% of respondents indicating that the floods issues in their communities are mostly caused by the lack of proper drains in the communities. Also, 88% associated it with disregard for building codes; 85% associated it with the habit of building permanent structures on waterways and 77% associated it with problem of choked gutters. Respondents again attributed floods in their communities to other factors such as waterlog area (69%), congested settlements (56), poor drainage design (54%), heavy rains (53%) and low lying nature of the land in the study communities (50%).

However, majority of respondents indicated that the floods issues in their communities had nothing to do with improper solid waste disposal, building on reclaimed land, impervious land surface, activities of other communities or as a mere act of God.

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Table 4.11: Factors that Contribute to Floods in the Study Communities

Variable	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Lack of drainage facilities	187	97.9	4	2.1
Disregard for building codes	168	88	23	12
Building on waterways	163	85.3	28	14.7
Choked drains	148	77.5	43	22.5
Waterlog area	132	69.1	59	30.9
Congested settlement with poor layout	106	55.5	85	44.5
Poor drainage design	103	54.9	88	46.1
Heavy rains	102	53.4	89	46.6
Low lying nature of the land	96	50.3	95	49.7
Improper waste disposal	85	44.5	106	55.5
Building on reclaimed land	40	20.9	151	79.1
Activities of other communities	24	12.6	167	87.4
Impervious land surface	18	9.4	173	90.6
Acts of God	18	9.4	173	90.6

Source: Field Survey June, 2017

The data received from the key informant and in-depth interviews also confirmed most of these factors as the major causes of floods in the study communities, with lack of proper drains being the most mentioned. The Assembly Member for Kowe/Abese/Abafum for example noted that

> "*the factors that cause floods in this community* (Adzeman) *are many however the number one factor has to do with the drains. As we speak now, there is no major drain in this community to carry the high volumes of runoff water whenever it rains. But you see water is water, you can't stop it; it must flow, so if you don't have drains to carry it, it will find its own way, and usually end up in people's buildings"* (Personal In-depth Interview, 24th June 2017).

The Municipal Development Officer, talking about Tse-Addo mentioned:

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"*Tse-Addo is a completely a new area, as we speak now the land is bare; water runs everywhere; I mean nothing controls nothing"* (Key Informant Interview 27th June, 2017).

The Assembly man for the Adiembra electoral area where Kenan Factory is located also stated that:

"we have places that even if it rains continuously for four days, they will never get floods, but there are other places even four minutes rains can cause floods, because they don't have drains".(In-depth Interview, 21st June 2017)

The municipal Engineer also stated that:

"*beside Tse-Addo which is relatively new area, all the other flood prone communities are ancient communities, they do not have modern urban design….They are so congested and lack access roads and drains; such communities need a whole settlement redesign to have solution to their problem*". (Key Informant Interview, 28th June 2017)

The issue of building on water ways, choked drains, improper solid waste disposal and building on reclaimed land among others also flagged up in the key informant and in-depth interviews.

These are consistent with the findings by (ActionAid 2006; Karley 2009; Rain *et al,* 2011; Okyere *et al*, 2012; Tumpale *et al,* 2012; Assumadu-Sarkodie *et al*, 2015) who in their respective studies identified defective engineering works, building on water ways, lack of drainage facilities, indiscriminate dumping of waste, lack of coordinated urban development among and poor enforcement of settlement codes among others as some major causes of floods in the urban area. Plate 4.2 for example shows the defective drain at Kenan Factory which is expected to

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carry storm water; and Plate 4.3 also shows waterlog lands which have been reclaimed for building at Tse-Addo.

Plate 4.2: Pictures showing the Main Drain at Kenan Factory

Source: Field Observation April, 2017

Plate 4.3: Land Reclaimed in Tse-Addo for Building

Source: Field Observation April, 2017

4.6 Effects of Floods

The research also looked at the effects of floods on households in the study communities. Figure 4.4 reveals that, as many as 96% of respondents indicated that their households have been

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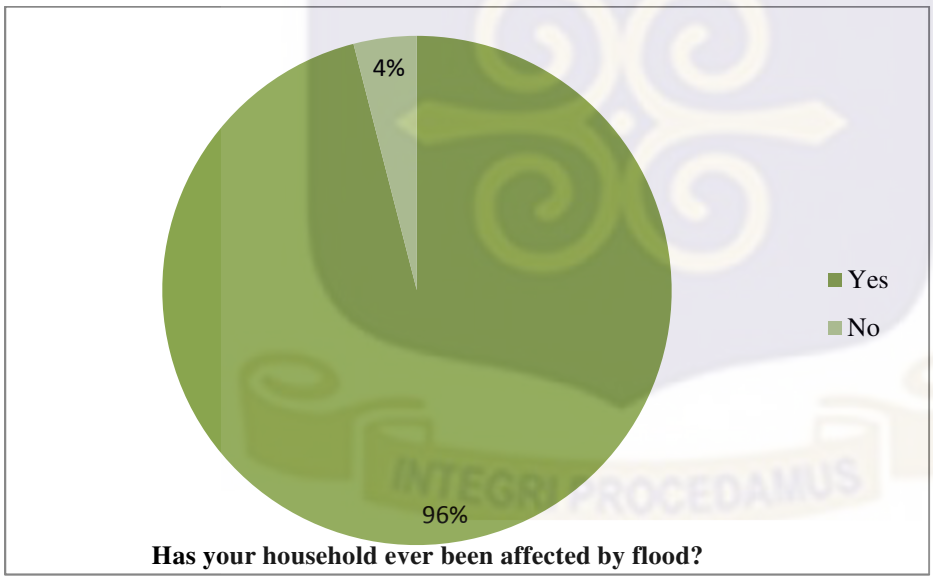
affected by floods as against 4% who said they have not been affected by floods. This implies that floods affect majority of households that participated in the study. Further analyses into the various dimensions in which households have been affected are shown in Table 4.12. The results reveal that out of the 184 households who have been affected by floods, about 3% of them have lost at least one household member through floods; 9% also have members who secured some physical injuries through floods; over 95% have also lost diverse household items through floods, and 60% have on some occasion acquired flood-induced diseases. Other ways some households have been affected by floods include loss of livelihood activity (31%), destruction to building and walls (43%), disruption in the supply of utility (51%), pollution of the environment (72%), erosion (60%), and frustrations and general inconvenience (62%).

Fig 4.4: Proportion of Households Affected by Floods



Source: Field Survey June, 2017

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Table 4.12: Effects of Floods in the Study Communities

Variable	Yes		No		Cannot Recall	
	Freq.	Percent.	Freq.	Percent.	Freq.	Percent.
Lost Household member	5	2.7	179	97.3	0	0
Caused injury to a Household member	17	9.2	152	82.61	15	8.2
Lost household items	175	95.1	7	3.8	2	1.1
Acquired flood-induced diseases	112	60.9	51	27.7	21	11.4
Lost livelihood activity	57	31	107	58.2	20	10.8
Destruction to building and walls	79	42.9	101	54.9	4	2.2
Disruption in supply of utility services	94	51.1	88	47.8	2	1.1
Pollution to the environment	133	72.3	49	26.6	21	1.1
Caused erosion of the vicinity	110	60.1	70	38.3	3	1.6
Frustration and general inconvenience	114	62	49	26.6	21	11.4

Source: Field Survey June, 2017

Like Sur *et al* (2000) wrote about the 1998 cholera outbreak in Bengal-India, the Assembly Member for Adiembra electoral area stated the malaria and cholera cases increase swiftly whenever floods occur as a result of stagnant water and the pollutions that are usually associated with floods. He further stated:

> "*a lot of people are displaced whenever floods occur; some people are displaced for more than one week. When I see what people go through, I can't even sleep; people lose their valuable properties in a blink of the eye"* (Personal In-depth Interview, 21st June 2017)

A community member also stated:

> *"as for floods I cannot sit here to explain for you to appreciate it well; it is very frustrating. When your entire room is flooded, your bed is wet, your fridge, television and other gadgets are spoilt, and you don't have a place to sleep, sometimes you have to sleep at the open spaces or in people's veranda, you become so hopeless and you*

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wish you were even dead…..people even faint out of this….so it's a big issue we are talking about here" (Personal In-depth Interview, 23rd June 2017).

The effects of floods on households in the study communities identified by this study are consistent with findings made by some other literature. For example, World Bank (2016) identified that as many as 150 lives were lost in Ghana during the 3rd June, 2015 floods at Circle. Du *et al* (2010) in their studies also identified that, during floods, a lot of people secure various degrees of injuries through collision with objects, collapse of buildings and electrocution. Addei (2016) also identified that, floods destroy the environment through pollution, creation of gullies on the street and destruction of vegetation. Similarly Smith & Ward (1998) also argued that floods pose a lot of intangible effects such as damage to health, loss of life, frustrations and disruption in the normal way of life. Nelson (2013) also identified that floods result in a number of secondary effects such as outbreak of water borne diseases; disruption in the supply of energy; Stress and mental trauma etc. Plate 4.4 shows pictures of walls of some buildings destroyed by floods in Adzeman and Kenan Factory.

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Plate 4.4 Walls of buildings destroyed by floods in Adzeman and Kenan Factory

Source: Field Observation April, 2017

4.7 Flood Adaptation Measures in the Study Communities

4.7.1 Flood Adaptation Measures by Households in the Study Communities

Flood adaptation is very important in offsetting the degree of destruction floods cause to households. As IPCC, (2001) argued, flood adaptation comes in three forms – anticipatory adaptation, autonomous adaptation and planned adaptation. World Bank & GFDRR (2012) also indicated that complete adaptation covers three phases of the floods – before floods, during floods and after floods. The study therefore sought to understand the adaptation measures households who have ever been exposed to floods employ at these phases during floods. The results are displayed in Fig. 4.5; Fig. 4.6 and Fig. 4.7 respectively.

Figure 4.5 shows that households activated various adaptation measures to prepare themselves for floods. Greater proportion of households (40%) said they did general cleaning and cleared choked gutters around their buildings to allow for easy flow of water whenever they suspected

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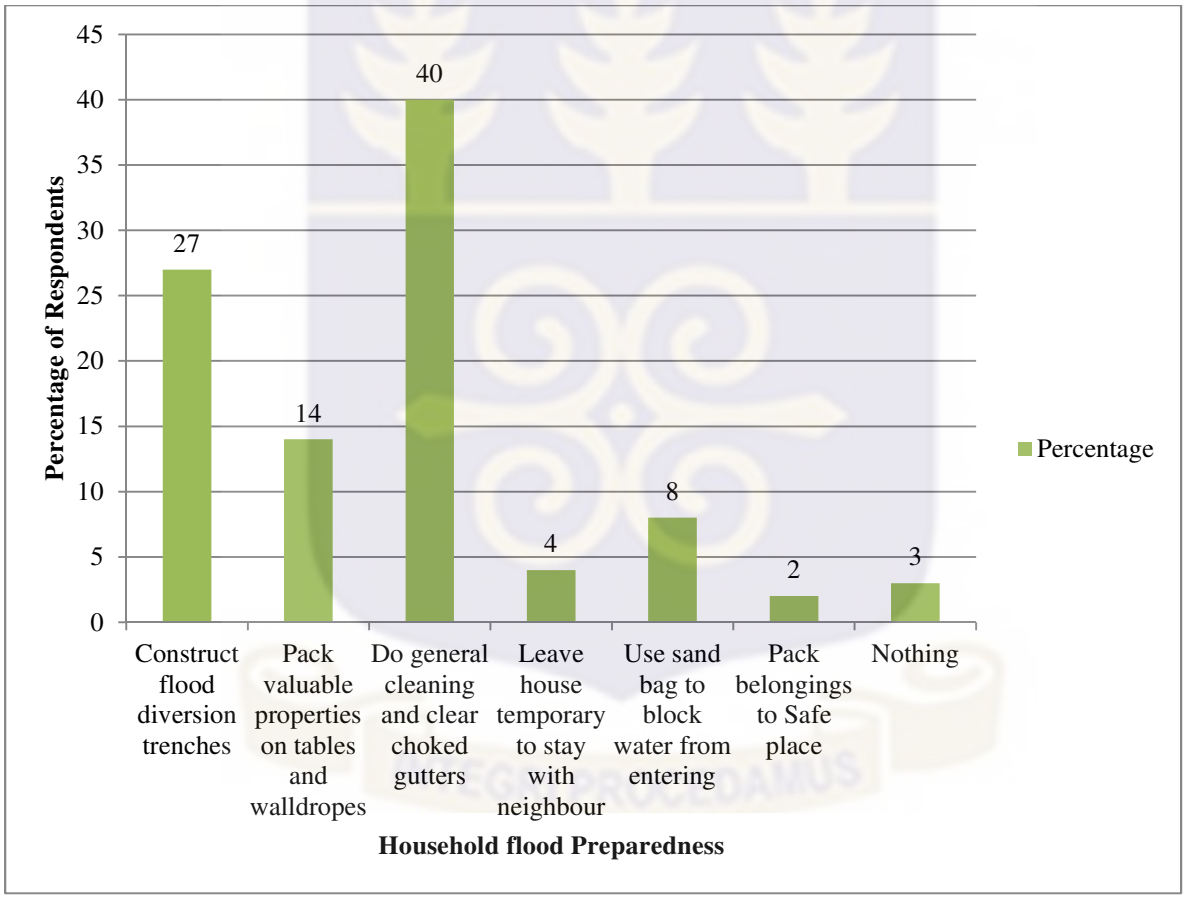
that floods were likely to occur; 27% of households also said they constructed flood diversion trenches to divert flood water away from the building; 14% also said they packed their valuable properties on top of tables and wardrobes to keep them safe from flood water; 8% also said they used sand bag to block flood water from entering their houses. Also 4% said they left the houses temporary to stay with their neighbours at safer communities till the floods receded; 2% said they packed some of their belongings to safer places, whereas 3% said they did nothing.

Fig 4.5: Flood Preparedness Measures by Households in the Study Communities



Source: Field Survey June, 2017

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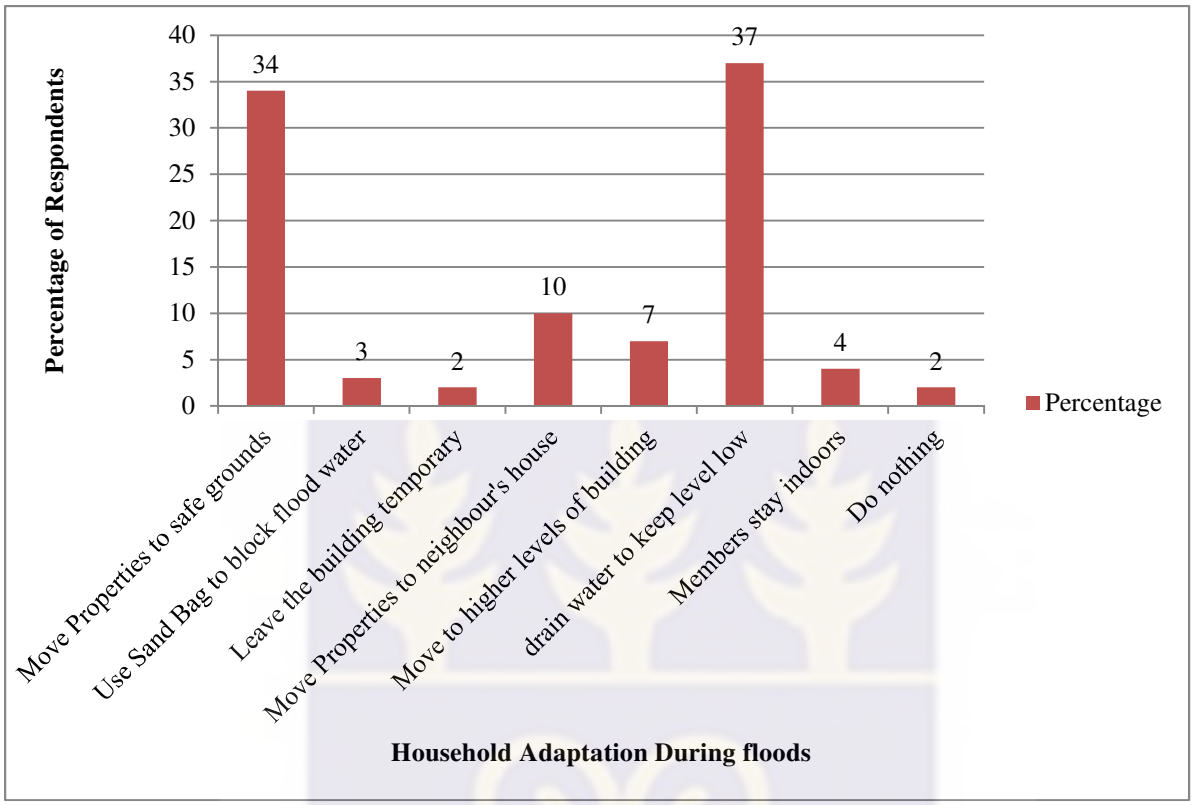
Fig 4.6: Adaptation Measures by Households during the Event of Floods



Source: Field Survey June, 2017

Figure 4.6 also shows when floods actually occur; respondents embark on several measures to protect themselves and their properties. About 37% of the respondents indicated that they consistently drain flood water from the building to keep the level low; 34% said they moved their valuable properties to safer and higher levels; 10% said they moved their valuable properties to neighbours' houses and 7% said they made sure all members moved to higher levels. Also 4% made sure all their members stayed indoors; 3% used sandbag to block flood water from entering the compound, 2% left the building entirely till floods receded and 2% said they did not really do anything.

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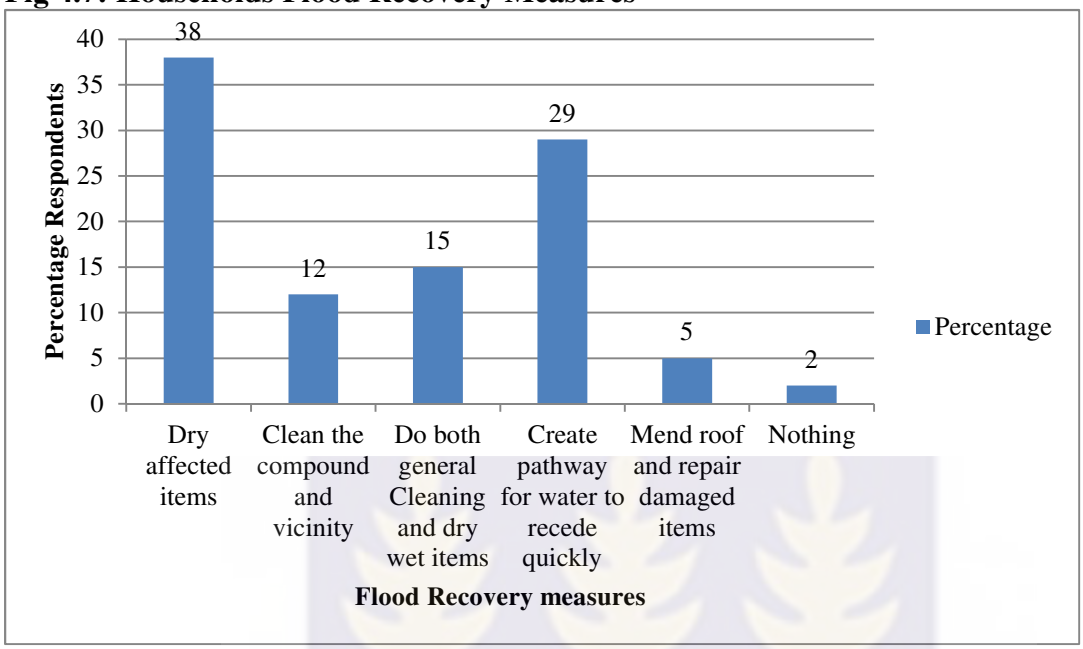
Fig 4.7: Households Flood Recovery Measures



Source: Field Survey June, 2017

Figure 4.7 also displays the post-flood recovery measures households adopted during the last floods their households experienced, 38% of the respondents said they dried their affected items; 29% created pathway or fixed pipelines for water to recede quickly; 12% cleaned their compound and cleared the refuse the floods have deposited in their vicinity; 15% did both general cleaning and dried wet items; 5% also mended their roof and repaired damaged items, whereas 2% said they did nothing.

These household adaptation measures are consistent with the ones recommended by the World Bank & GFDRR (2012) for Integrated Urban Flood Risk Management. They are also similar to the adaptation measures identified by Tumpale *et al* (2012) in Keko Muchungwa, Dar es Salaam in Tanzania and the ones identified by Douglas *et al* (2008) in their study involving five cities in Africa which revealed that households used several flood adaptation measures such as blocking flood water with sand bag; constructing flood diversion trenches; clearing choked gutters;

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installing pipe outlets to drain off water, temporal relocating to neighbours' houses, packing valuable properties on top of tables and wardrobes, drying wet items and embarking on general cleaning to clear all filth deposited by the flood water from the compound and the vicinity among others. Plate 4.5 for example shows a picture of sand cleared from a choked gutter in front of a building in Kenan Factory and Plate 4.5 also shows a picture of some sandbags kept to be used by a household in Tse-Addo during floods

Plate 4.5: Sand Cleared from a Choked Gutter in Front of a Building in Kenan Factory

Source: Field Observation April, 2017

Plate 4.6: Sand Bags field to Block flood water at Tse-Addo

Source: Field Observation April, 201

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4.7.2 Community Based Adaptation Measures

The World Bank & GFDRR (2012) framework for Integrated Urban Flood Risk Management recommends that, for successful adaptation, flood adaptation should not be limited to individuals and households alone; it should also involve other stakeholders especially those at the community level. Douglas *et al,* (2008) and Tumpale *et al,* (2012) studies also found out that community members can come together for collective flood adaptation by weeding around drains and clearing choked gutters; communal evacuation of affected people and their properties, and through the establishment of standing community emergency rescue team to provide rescue services to flood victims. This study therefore probed into the adaptation measures adopted collectively by community members to enhance their adaptive capacities. The results are displayed in Table 4.13 which show that only 32% of respondents indicated they have seen members of the communities coming together with collective flood adaptation measure. However, about 68% of respondents indicated that they have not seen any collective community-based adaptation initiatives taken in their communities.

Table 4.13: Community Level Flood Adaptation Measures in the Study Communities

Variable	Frequency	Percentage
Any Community Flood Adaptation Measure?		
Yes	61	31.94
No	130	68.08
Community Adaptation Measures Installed		
Help in Evacuating affected Members	25	40.98
General Cleaning and Clearing Choked Gutters	27	44.26
Providing temporal accommodation for affected members	9	14.75
Any Community -Based flood Emergency team		
Yes	0	0
No	174	91.1
Don't Know	17	8.9
Community Flood Emergency Team Necessary?		
Yes	189	98.95
No	2	1.05

Source: Field Survey June, 2017

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Also, enquiries into whether or not the communities have standby flood emergency team show that none of the communities have some; however, 99% of respondents think it is necessary for their communities to have one; which is consistent with the World Bank & GFDRR (2012) guidelines. In as much as all the Assembly men and the institutional heads who were interviewed also think likewise, most of them are doubtful of the feasibility of such teams since there will not be any funds set aside to remunerate them. The Assembly man for Adiembra electoral area for example exclaimed:

> "*who will pay them? .....though it would have been good to have such team, I don't know if anybody will be willing to pay them"*(Personal In-depth Interview 21st June 2017)

The Municipal NADMO coordinator also intimated that,

> "*though we will say they are voluntary team, no one will be willing to volunteer until you are ready to give them something"*(Key Informant Interview, 27th June 2017).

These arguments pose some challenges to the realistic implementation of the recommendations by the World Bank & GFDRR (2012) Integrated Urban Flood Risk (IUFR) framework that, to ensure all-inclusive and less costly flood adaptation, voluntary community-based flood emergency teams should be established in all flood-prone communities to provide quick emergency response their community members.

4.7.3 Institutional Flood Adaptation in the Study Communities

Again, the research enquired into the adaptation measures installed by government and other institutions in the study communities to enhance the adaptive capacities of the residents. Table 4.14 displays the results.

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Table 4.14: Analysis of Institutional Flood Adaptation Supports to Study Communities

Variable	Frequency	Percentage
Do you report Flood Incidence to any Authority?		
Yes	163	85.3
No	28	14.7
Why don't you Report?		
Don't know who to report to	6	21.4
They don't help to address the situation	12	42.9
They are not available	10	35.7
Who do you Report to?		
NADMO	159	97.6
Assembly man	128	78.5
TCP	19	11.7
Have ever received any assistance?		
Yes	122	74.9
No	41	25.1
What Assistance did you receive?		
Provision of Emergency Evacuation	5	4.1
Provision of Relief items	117	95.9

Source: Field Survey June, 2017

From Table 4.14, the results show that 85% of respondents report their flood cases to authorities while 15% do not report. Among those who do not report flood cases to any authority 43% explained that they don't report because the authorities have failed to address the situation; 36% also said it is because the authorities are not available to be reported to, whereas 21% said it is because they do not know who to report to. For those who report, 98% said they report to NADMO; 79% also said they report to their Assembly men and only 12% said they report to the Town and Country Planning Unit at the municipality. Further analysis however revealed that whereas 75% of them have received some assistance before, 25% indicated they have never received assistance from any of the institutions they report the flood cases to. This implies that not all the people who report flood cases to relevant authorities receive some assistance. Enquiries into the kind of assistance the 75% received however revealed that, 96% of them were given only relief items while 4% were given emergency evacuation service. The implication is

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that, the concept of planned adaptation measures which were identified by IPCC (2001) and World Bank & GFDRR (2012) as the most important measure for sustainable adaption have not yet receive much attention in the study communities. The municipal NADMO coordinator explained that:

> "*the people have lost confidence in NADMO because they think we have been deceiving them; but it is not our fault; we can only go there and pick the information on the ground and then report to the assembly and copy our regional office for action to be taken. Unfortunately our recommendations have not been responded to as expected. Even the relief items we receive for the victims usually delay; sometimes it takes more than a month after the request before they are brought and they are usually woefully inadequate. They are not able to restore the victims to their original states before the floods"*. He further intimated "*the truth must told, the authorities are not helping for the issue to be addressed; if people are given building permits to build on waterways, structures that must be demolished are not demolished, drains are not expanded, refuse form heaps in the street, what do you expect?……if we really want to address the situation, we all have to sit down and take certain bold decisions, until then the condition will remain the same. If somebody loses property worth thousands of cedis and you only compensate him with rubber bucket, mosquito coil, student mattress and bed sheet, wouldn't he feel insulted? These days when we even go to the communities they are not willing to give us the information because they know we will not do anything about the situation"*. (Key Informant Interview, 27th June, 2017)

At Fisheries, some community members mourned over a bridge which was destroyed by floods over two years ago but has remained a death trap to residents and motorists, yet nothing has been

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done about it despite the numerous complaints community members have sent to the authorities requesting for immediate repairs. Plate 4.6 shows some section of the bridge.

Plate 4.7: A bridge at Fisheries destroyed by Floods

Source: Field Observation April, 2017

4.8 Mitigation Strategies to Floods

The researcher sought to explore the mitigation measures installed in the study communities to minimize the future occurrence of floods if not totally forestall it. This was assessed at three levels – households' mitigation measures, community based mitigation measures and institutional mitigation measures.

4.8.1 Households Flood Mitigation Strategies

An analysis of the mitigation measures adopted by households in the study communities to forestall the future occurrence of floods and its related menace as displayed in Table 4.15 reveals that, about 84% of the total households have installed some mitigation measures. The other 16% who have not installed any measure to mitigate floods gave diverse reasons for their inactions; some explained that they don't have enough resources to install mitigation measures (44%), and

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others feel they cannot do anything about the situation due to the nature of the land (56%). *(See table 4.16)*. These explanations confirm the argument made by Wamler (2006) that, lack of financial resources remains a major reason why most urban poor who dwell in high flood-risked communities are not able to install appropriate measures to control floods.

Among those who have installed some mitigation measures, the results in table 4.15 give some suggestions that construction of drains around building (63%); construction of flood protection walls around building (69%) and clearing of choked gutters (78%) are the most popular measures adopted by households who participated in the study as compared to the other mitigation measures. Further enquiry into households flood mitigation measures on the basis of households' average income does not seem to suggest any clear pattern of distinction between the mitigation measures installed by households in the lower income categories from those in the upper income categories.

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Table 4.15: Flood Mitigation Measures by Households in the Study Communities

Household Flood Mitigation	Household Average Monthly Income (%)					General (%)
	100-500	600-1000	1100-1500	1600-2000	2000+	
Household mitigate Floods?						
Yes	80.4	81.5	92.3	85.7	100	84.3
No	19.6	18.5	7.7	14.3	0.0	15.7
Flood Mitigation Measure Installed						
Construction of drains around building						
Yes	66.7	57.6	62.5	83.3	57.1	62.7
No	33.3	42.4	37.5	16.7	42.9	37.3
Building flood protection walls						
Yes	44.4	78.2	79.2	83.3	71.4	68.9
No	44.6	21.8	20.8	16.7	28.6	31.1
Clearing Choked gutters						
Yes	68.9	80.5	83.3	75.0	92.9	78.3
No	31.1	19.5	16.7	25.0	7.1	21.7
Raising doors and window levels						
Yes	42.2	33.3	25.0	25.0	21.4	32.9
No	57.8	66.7	75.0	75.0	78.6	67.1
Elevation of Building foundation						
Yes	26.7	9.1	8.3	0.0	7.1	13.0
No	73.3	90.9	91.7	100	92.9	87.0
Constructing flood diversion trenches						
Yes	40.0	39.4	45.8	33.3	78.6	43.5
No	60.0	60.6	54.2	66.7	21.4	56.5
Blocking flood water with sandbags						
Yes	35.6	22.7	20.8	41.7	42.9	29.2
No	64.4	77.3	79.2	58.3	57.1	70.8
Installing Pipe outlets to drain water						
Yes	31.1	37.9	33.3	25.0	35.7	34.2
No	68.9	62.1	66.7	75.0	64.3	65.8

Source: Field Survey June, 2017

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Table 4.16 Household Mitigation Measures Successes and Setbacks

Variable	Frequency	Percentage
Reason for not Mitigating floods		
There is nothing I can do due to the nature of the land	14	43.7
Lack of financial resources	18	56.3
Success of mitigation measure		
Yes	98	60.9
No	63	39.1
Observed Changes		
Reduction in the Occurrence of Floods	9	9.2
Reduction in the level of disaster caused by floods	83	84.7
Both	6	6.1
Reasons for Mitigation Failure		
Measure not adequate	50	100
Any plans to relocate		
Yes	71	37.2
No	120	62.8
Reasons for no Relocation Plans		
Reduction in the effect of floods	10	8.7
Lack of finance	46	40.0
Have nowhere else to go	20	17.3
Cannot leave own property	33	28.7
Confident that the problem can be solved	6	5.3

Source: Field Survey June, 2017

Further enquiries also revealed that, about 61% of households who have installed some mitigation measures indicated their mitigation measures have been successful. Out of these, about 85% said they have seen some reduction in the level of disaster caused by floods in recent times, whereas 9% said there has been some reduction in the current occurrence of floods and 6% also said they have seen reduction in both cases. However the 39% who said the mitigation measures have not been successful think that it is because the measures they installed were not adequate to forestall the future occurrence of floods.

Also Table 4.16 reveals that, even though floods are considered by respondents as worrying, only 37% said they have plans to relocate to alternative communities; the other 63% have no relocation plans for diverse reasons such as lack of funds (40%), cannot leave their own

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properties (28%), have nowhere else to go (17%), reduction in the current occurrence of floods (9%) and those who said they have confidence that the floods problem can be solved (5%). The implication here is that, contrary to the World & GFDRR (2012) recommendation of permanent relocation as an alternative and sustainable mitigation measure, most members from the study community are not likely to accept that recommendation. During the in-depth interviews of some community members, one of them exclaimed:

> *"you know that the cost of rent in Accra is very expensive, even a room for just myself alone I cannot afford, let alone going to rent a place that can accommodate all of us. At least this place is a family house; we don't pay any rent so we will manage it like that"* (Personal In-depth Interview, 29th June 2017).

Another member stated to imply his unwillingness to relocate:

> *"tell me where I should go; sometimes when people ask that question I don't know what to tell them. Look at my age now; this is where I have lived ever since I was a child, where do you suggest I should move to?"* (Personal In-depth Interview, 27th June 2017).

To enhance the resiliency of people towards floods, the World Bank & GFDRR (2012) recommends subscription to flood insurance policy as a major tool in the integrated urban flood risk management. Flood insurance is seen as important tool by the framework for two reasons – to enable flood victims to have somebody they can share their risk with; and also the fact that the insurance company will make sure households who have signed on to their policies did not deliberately engaged in things that will increase their risk of getting floods helps to serve as check in reducing flood disaster. The study explored the popularity of flood insurance among community members. The results in table 4.17 show that, out of 191 households that participated

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in the study, only 2% said they have subscribed to flood insurance policy, whereas the remaining 98% said they have not. Among those who have subscribed, 50% have insured their building while the remaining 50% have insured their furniture and electronic devices. Also 50% of the respondents who have insured hold their policy with Vanguard Assurance and the other 50% hold their policy with Enterprise Life Assurance Company (ELAC). Among those who have not insured, 68% said they are willing to subscribe where as 32% said they are not interested in any flood insurance subscription.

Table 4.17 Households Flood Insurance Subscription

Variable	Frequency	Percentage
Household subscribed flood insurance?		
Yes	4	2.1
No	187	97.9
If no, do you wish to insure?		
Yes	128	68.4
No	59	31.6
If Yes, what household items have insured?		
Building	2	50.0
Furniture and electronics	2	50.0
With which Insurance Company?		
Vanguard Assurance	2	50.0
ELAC	2	50.0

Source: Field Survey June, 2017

Even though flood insurance seems to be a new but embracing idea for most of the respondents in the survey and key informants, the Municipal Development Planning officer expressed the fear that flood insurance policy will help to perpetuate illegal developments;

> "*we are trying to find a solution to a problem; if you then give insurance to people who have built on water ways and others, then you are encouraging them to continue that wrong behavior……if the insurance company will do a background check to see that*

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people who subscribe to their policy have building permit, and are doing the right things, then I don't have problem with that; but if they will not do such checks, I don't think flood insurance will be helpful"(Key Informant Interview, 27th June, 2017)

4.8.2 Community Based Mitigation Strategies

Table 4.18 and Figure 4.8 display community based flood mitigation measures. As shown in Table 4.18, 52% of respondents indicated that, they have seen their community members embarking on collective flood mitigation in their communities, whereas 48% said they have not seen such community measure. Community by community analysis displayed in Figure. 4.8 shows, majority of respondents in Adzeman, Kenan Factory and Fisheries confirmed that they have seen some mitigation measures adopted collectively by their community members. At Tse-Addo, the results were 50% at par; Whereas at Pentecost Down, as many 74% of respondents indicated they could not confirm any concrete collective measure taken by their community members to mitigate floods. The implication is that, even though some community-based mitigation measures as recommended by World Bank & GFDRR (2012) are carried out in all the study communities, they are not universally prominent for all the communities.

Further analysis with those who confirmed that they have seen their community members taken collective flood mitigation actions shows that, 34% said their community members come together to desilt choked gutters; 32% also said their community members construct flood diversion trenches; 16% said their community members do clean up exercises. Also 10% and 8% respectively said their communities embark on flood education and block flood water with sandbags. A community member in Tse-Addo for example mentioned during an in-depth interview that:

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> "*we have a Resident Association here which is made up of all the land lords in this community…… we do some contributions and through that we hire people to create channels in the community to link them to Korjor River. That is what we did last year that, the floods minimized; this year too, we have made our contributions, so we are expecting that channels will be created very soon"* (Personal In-depth Interview, 23rd June 2017)

Also, those who said their communities have not installed any collective measure to mitigate floods gave several reasons for that. 49% said, it is because there is lack of cooperation among community members; 14% said because they think it is government's responsibility to do that; 12% said because they lack strong leadership and other 12% said community members do it individually; 13% however said they cannot explain the reason why their communities have not taken any collective initiative to mitigate floods. In reaction to this, the Assemblyman for New Lakpanaa electoral area mourned that, it is very difficult to organize the community members in recent times, as people seem to be busy with their own businesses. Citing the monthly cleanup exercise as an example, he argued that:

> "*even the monthly clean-up exercise that the previous government initiated which was meant to help all of us, the community members refuse to attend; you can do all the announcement, organize for tools and do everything, but not a single person will come out to participate"* (Personal In-depth Interview 24th June 2017)

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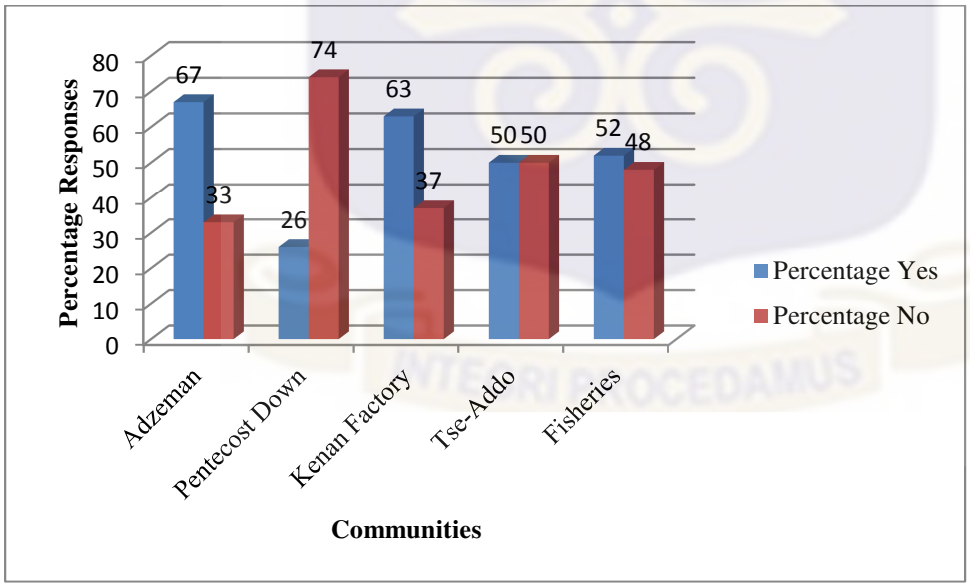
Table 4.18 Community based Flood Mitigation in the Study Communities

Variable	Frequency	Percentage
Any Community Mitigation Measure		
Yes	100	52.4
No	91	47.6
If yes, What Measures have been installed		
Created Flood diversion trenches	32	32.0
Desilting of choked gutters	34	34.0
Block flood water with sand bag	8	8.0
Clean up Exercise	16	16.0
Education on Floods	10	10.0
Reasons for no Mitigation		
It is Government's Responsibility	13	14.0
Lack of Cooperation among community members	46	49.5
People do it Individually	11	11.8
Lack of Strong Leadership	11	11.8
Cannot tell	12	12.9

Source: Field Survey June, 2017

Fig. 4.8: Analysis of Community by Community Flood Mitigation Measures



Source: Field Survey June, 2017

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4.8.1 Institutional Mitigation Measures in the Study Communities

The study further made enquiries into the mitigation measures the central government, city authority or any other institution has installed in the study communities to forestall the future occurrence of flood disaster. The results displayed in Table 4.19 show that mitigation measures by government and other institutions are not so visible in the study communities. Beside flood awareness campaigns which about (71%) of the respondents confirmed that they have seen government (NADMO) does occasionally, greater proportion of respondents indicated they have not seen the government or any other institutions installing other measures in their communities to mitigate floods. Quite interestingly, even among those who said that they have seen government and other institutions activate some mitigation measures in their communities, Table 4.20, shows that only 33% of them said the mitigation measures have been successful; with the argument that they have seen some reduction in the occurrence of floods (19%) and some reduction in the damages caused by floods (76%) in recent times. The remaining 67% said the institutional mitigation measures have not been successful, indicating that it is because they are not done timely (36%), not usually completed (34%), not done regularly (30%), not done properly (47%), defective monitoring (26%) or communities are not involved (18%).

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Table 4.19 Institutional Flood Mitigation Measures in the Study Communities

Variable	Yes		No		Don't Know	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Constructing drains	69	36.1	105	55	17	8.9
Desilting drains	82	42.9	96	50.3	13	6.8
Clearing waterways	45	23.6	132	69.1	14	7.3
Flood awareness campaign	135	70.7	47	24.7	9	4.7
Issuing early warning signals	56	29.3	121	63.4	14	7.3
Preventing unauthorized structures	14	7.3	155	81.1	22	11.5
Demolishing unauthorized structures	26	13.7	143	74.9	22	11.5
Solid waste collection and management	31	16.2	144	75.4	16	3.4
Protecting wetlands and floodways	12	6.3	148	77.5	31	16.2

Source: Field Survey June, 2017

Table 4.20: Success of Institutional Flood Mitigation Measure

Variable	Frequency	Percentage
Has Institutional Mitigation been Successful?		
Yes	58	32.58
No	120	67.42
If yes, What Changes have you seen?		
Reduction in the Occurrence of floods	11	18.97
Reduction in the level of destruction	44	75.86
Both	3	5.17
If No, What may be the reason?		
Not done timely	39	35.5
Was not completed	41	34.17
Not done regularly	36	30
Not done properly	56	46.67
Ineffective Monitoring	31	25.83
Community members are not involved	22	18.33

Source: Field Survey June, 2017

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In reacting to the failure of government institutions to install mitigation measures in the study communities , the Municipal NADMO coordinator bemoaned in his statement that,

> *"not much has been done in those communities; we have written several reports to the assembly but we are yet to see any serious action taken…….as I sit here, I can tell you that, I don't foresee any positive change until those in authority will take bold decisions to step in……even our budget for doing disaster awareness campaign and for issuing early warning signals are rarely financed"* (Key Informant Interview, 27th June 2017)

The Municipal Development officer also admitted that the drainage systems in most of the communities have serious defects, he expressed in a statement that:

> "*most of the drains in the indigenous communities were built during the times of Acheampong (1970s) and so they are very narrow……we have done some expansion but they are not enough".*(Key Informant Interview, 27th June 2017)

The implication is that, government institutions, most especially the municipal authority have not been proactive in finding lasting solutions to the flood menace. Besides, not a single private organization or philanthropist was found to have made any initiative to help mitigate floods in the study communities. These confirm Wamler (2006) argument that, the fact that mitigation measures do not offer quick returns to government and donors, they are usually less motivated to finance their installations.

The Municipal Engineering Officer however revealed the plans underway to redesign the drainage system for the entire municipality. He indicated that:

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"*drains are the major concern for most of the communities in the municipality; a lot of places get flooded with moderate rain. But what we are saying is that, the fundamentals of it, is to have a drainage plan for the municipality; to look at the volume of water that flood the communities and know what type of drains are needed to curb the situation if not totally eradicate it……in collaboration with the development planning unit, we have initiated discussions with the Hydrological Service Department (HSD) to step in to help in designing a drainage plan for the municipality"*. (Key Informant Interview, 28th June 2017)

Municipal Development Planning Coordinator also revealed that, the whole area of Tse-Addo will be undergoing the process of drainage redesign and road construction. In his statement:

"*Tse-Addo is a completely new area and so there are plans underway to construct roads and redesign the drainage system. As we speak now, nothing controls anything, but the government has devoted money to construct a total of 21 kilometer roads within the community with drains attached; the moment that is done, their problem will be solved"*.(Key Informant Interview, 27th June 2017)

The Municipal Finance Officer also indicated that even though some money was devoted for works to be done on the drainage system in Kenan Factory, the institutional bottlenecks of tendering and retendering delayed the process, and so there are hopes to begin work in that community soon. The Chairman of the Works and Disaster Sub-committee also indicated that there were plans underway to desilt most of the drains in the communities before the rains get heavy. In his statement

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"*I have gone to do an inspection of the drains in all the communities together with the Municipal Chief Executive, and so we will be desilting all the major drains before the rains get heavy"* (Key Informant Interview, 30th June 2017)

These reactions give indications that, even though the city authorities have initiated various programs to address the flood menace in the study communities, they are yet to see physical implementation.

Further enquiries were made into whether or not community members will be willing to collaborate with government and other institution to mitigate floods. The results as displayed in Table 4.21 reveal that, about 94% respondents indicated their willingness to support as against 6% who responded no. Also only 32% who are willing to collaborate with government indicated that they will be willing to contribute financially towards government's flood mitigation initiatives in their communities. The other 68% said they will not contribute financially; however 37% are willing to participate in clean up exercises, 22% want to assist in given public education, 15% said they will give free labour, 6% said they will give necessary information needed on the ground but 20% said they will not do anything else. A community member in Tse-Addo indicated when he was asked if he will be willing to contribute financially that:

"*why not? If only they will use the money for the intended purpose, I am ready to help; after all who will benefit, is it not me? I don't have problem at all"* (Person In-depth Interview, 23rd June 2017)

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Table 4.21: Households Willingness to Support Government

Variable	Frequency	Percentage
Willing to Collaborate with government?		
Yes	179	93.7
No	12	6.3
Willing to Support Financially?		
Yes	61	31.9
No	130	68.1
Other ways you are willing to support government		
Nothing Else	36	20.1
Offer free labour	26	14.5
Participate in Clean up exercises	67	37.4
Assist in Public Education	39	21.8
Provide the necessary Information on the ground	11	6.2

Source: Field Observation June, 2017

4.9 Constraints to Household Flood Adaptation Constraints

The constraints the confront households in adopting flood adaptation measures were analyzed; the results are displayed in Figure 4.9 and 4.10. Figure 4.9 shows that 96% of households sampled for the study encounter some challenges as against 4% who said they don't face any challenge. Enquiries into the kind of challenges the households face (Figure 4.10) reveals that 49% of the households lack financial resources to embark on the efficient adaptation; 36% complained about the lack of cooperation among community members, whereas 15% of them said they are constrained by the reckless behavior of some community members. A community member at Kenan Factory mourned over some reckless behavior of some community members

> "*sometimes people deliberately drop their refuse into the drains whenever it is rains expecting that the water will carry them away"*(Personal In-depth Interview, 22nd June 2017).

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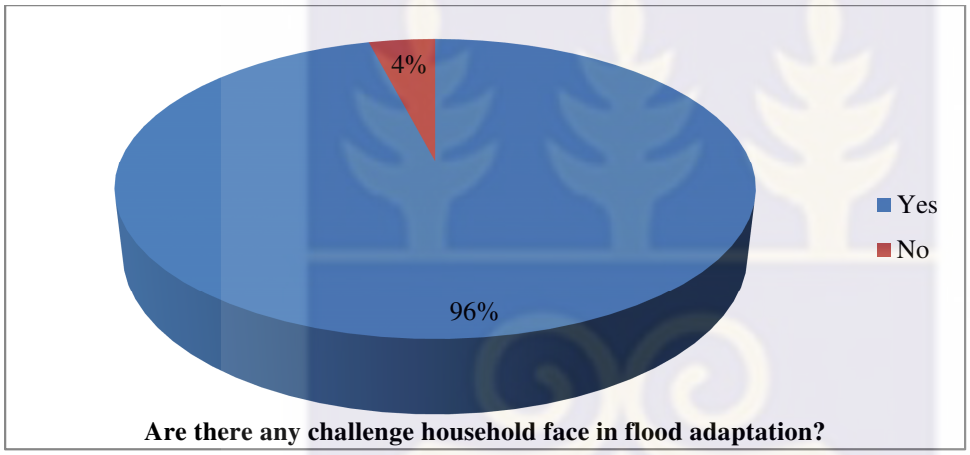
The Assembly member for Kowe/Abese/Abafum also mourned over the apathetic lifestyle of the people

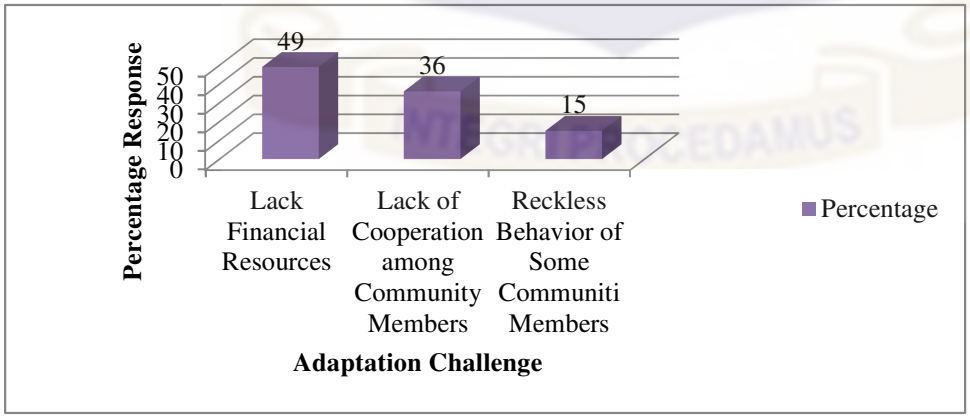
> *"everybody wants to do his own thing, nobody listens to advice, but when they are flooded then they start calling the me……..sometimes people must be made to take responsibility for their own actions"* (In-depth Interview, 24th June 2017)

Fig 4.9 Challenges to Household flood Adaptation



Source: Field Survey June, 2017

Fig. 4.10 Exact Flood Adaptation Constraints Facing Households



Source: Field Survey June, 2017

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4.10 Constraints to Household Flood Mitigation

Enquiries were also made into the mitigation challenges that confront households and other stake holders; the results are displayed in table 4.22. It reveals that 97% of households that participated in the study said they face some flood mitigation constraints as against 3% who said they do not face any constraint. Similar to the adaptation constraints, 90% of households indicated that they do not have enough financial resources to embark on appropriate mitigation; 79% spoke about lack of cooperation among community members as a challenge; 78% mentioned lack of support from government as a big challenge; 50% of them also mentioned the reckless behavior of some community members as a challenge, whereas 26% said they lacked the right skills to install the appropriate mitigation measure.

In suggesting solution to the mitigation challenges they encounter, 29% of respondents recommended that government should commit more resources into flood mitigation; 26% also said there should be an improvement in flood awareness campaigns, whereas 24% suggested that the authorities should put up more drains. Also 13% suggested that all unauthorized structures built on waterways should be pulled down; 5% called on community members to participate in communal labour and 3% suggested that other non-state actors should get involve in address the situation.

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Table 4.22 Household's Flood Mitigation Challenges in the Study Communities

Variable	Frequency	Percentage
Mitigation Challenge?		
Yes	185	96.9
No	6	3.1
Exact Mitigation Challenge		
Inadequate financial resources	166	89.7
Lack of cooperation among community members	146	78.9
Reckless behaviour of some community members	93	50.3
Lack of support from the government	145	78.4
Inadequate skills to install the right mitigation measure	48	26.0
Recommendations for Addressing Mitigation Challenges		
Improve flood awareness campaign	48	26.0
Government should commit more resources into mitigation	54	29.2
Other non-state actors should get involve	6	3.2
Build more drains	44	23.8
Pull down all unauthorized structures	24	13.0
Improve on communal labour	9	4.9

Source: Field Survey, June 2017

Similarly, all the key informants who participated in the study cited inadequate financial resource as the main challenge confronting their efforts to mitigate floods. The Municipal Finance Officer for example mentioned:

> "*it all boils down to money; if we had money all the good plans we have would have been enrolled. Nobody is happy about the situation; after all it is an indictment on the image of the assembly. I don't think there is anybody here who will be happy when people's houses are raided by floods and their properties destroyed*". (Key Informant Interview, 30th June 2017)

The Municipal NADMO Director also added that beside finance, their staff do not have enough training to equip them with the skills to rescue flood victims when they called. He indicated that

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> *"when it gets critical, we usually call on the services of the fire service and the military to come and support us……if our staff were trained like the military or the police, we would have been more endowed to attend to some of these emergencies"*. (Key Informant Interview, 27th June 2017)

He further indicated that because the community members have lost faith in the NADMO, they find it difficult in winning their cooperation. These challenges confirm the ones mentioned by Wamler (2006) and World Meteorological Organization (2008) studies, and those in the World Bank &GFDRR (2012) guidelines.

4.11 Conclusion

This chapter concentrated on the analysis of the data obtained from the field studies on the flooding issues in the study communities. Several issues were captured and analyzed; this included the background characteristics of the respondents; the socio-demographic characteristics of households; the occurrence of floods in the study communities; the causes of floods and the effect of floods on households in the study communities. The chapter also looked at the flood adaptation measures and flood mitigation measures installed by households, the community; government and other institutions to address flood disaster issues in the study community. Also the constraints that households and other stakeholders face in adapting and mitigating floods were given attention. This chapter is very relevant as it gives primary information on floods and how it unfolds in the study communities. This will help in identifying the appropriate recommendation for addressing flood disaster in the study communities.

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CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings of the study in relation to the set objectives; and on that basis, it draws conclusion and makes recommendations for policy purposes and for future research.

5.2 Summary of Key Findings

Over the decades, flood has been and continues to remain a major disaster that threatens the development of most cities in the world (UNDSEA, 2016). As Askew (1997) explained, of all natural disasters, floods contribute most to all deaths, all injuries and all economic damages caused by natural disasters. The frequency of occurrence of floods in Accra has received the attention of the media, researchers and institutions recent times. In LaDMA, floods remain the leading natural disaster in the municipality. The study sought to assess the adaptation and mitigation strategies that stakeholders adopt in managing the occurrence of floods in the flood-prone communities in LaDMA. The study had four specific objectives which captured the causes of floods, the effects of floods, the adaptation measures to floods, the mitigation strategies to floods and constraints faced by stakeholders in flood adaptation and mitigation. To achieve these objectives a survey involving 191 households sampled from five selected communities was conducted, and the data obtained were supported with qualitative data obtained through key informant interviews of six heads of department in LaDMA, and an in-depth interview of five Assembly men from the study communities and five Community Members. The key findings are summarized under the objectives of the study as follows.

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5.2.1 The Occurrence of Floods in the Study Communities

The study identified that, about 98% of households that participated in the study have had experience with floods before. Out of these, about 53% have experienced floods eight times and over; also about 85% of the households sampled for the study experienced their last flood within the past six months. It was also revealed that, in spite of the slight variations, flood incidences in all the study communities usually occurred between the months of May and August, and this gives some level of predictability for policy purposes. Again, it was revealed that, with the exception of Fisheries which usually experienced flash floods, all the other study communities experienced inland flooding. The implication as explained by the National Weather Service Organization (2002) is that, flood water can stagnate in the communities for a long time before draining, and this can serve as breeding ground for mosquitos if proper measures are not taken.

5.2.2 Causes of Floods in the Study Communities

The study found out that, flood phenomenon in the study communities has several underlying causes. Though some natural conditions such as the impervious nature of land surface, low lying nature of the land and heavy downpour of rain were identified to be contributing flooding in the study communities, the most prominent causes of floods found were anthropogenic, with lack of drains being the most dominant. Other anthropogenic factors identified were disregard for building regulations; building on waterways; choked drains; poor drainage design; improper solid waste disposal; congested settlement, among others. These findings are in line with the argument made by Hualou (2011) that, even though flood is generally seen as natural phenomenon, it is further worsened by anthropogenic activities resulting from man's interaction with the natural environment.

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5.2.3 Effects of Flooding on households in the Study Communities

The study also found out that floods have several negative effects on households in the study communities, and this confirms the findings made by some literature such as (Ahem &Kovats, 2005; Jonkman & Kelman, 2005; Nelson, 2013; Addei, 2016 and World Bank, 2016). These include loss life of some household members (3%); physical injury to some members of the household (9%); loss of household items through floods (95%); loss of household livelihood activities (60%); destruction of buildings and walls (43%); pollution of the environment (72%); erosion (60%); frustrations and general inconveniences (62%).

5.2.4 Households' Adaptation Measures to Floods

The studies further revealed that, variety of adaptation measures are used by households to enhance their adaptive capacities. Similar to the guidelines given by IPCC (2001), household flood adaptation measures are carried out in all the three phases of flood events, namely before floods, during floods and after floods (i.e. flood recovery measures). Before floods actually occur households put up several anticipatory adaptation measures such as clearing choked gutters; constructing flood diversion trenches; packing valuable properties on top of tables and wardrobes; using sandbags to block water from entering the house; leaving the house temporary to stay with and packing valuable properties to safer places. During the period where floods actually occur, the adaptation measures households adopt include draining water from the building to keep the level low; moving valuable properties to safer and higher levels; moving properties to neighbours' houses; making sure all the members stayed indoors; blocking flood water with sandbags and some leaving the houses temporary till flood receded. Similarly, after the flood events, households put up some measures to enhance their recovery. Among those

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identified by the study include drying affected items; cleaning the compound; mending the roof and repairing damaged items.

5.2.5 Community based Adaptation Measures

Regarding community based adaptation, the study found out that, in most of the communities, members did not usually come together to install any collective adaptation measure. However on the few occasions that members were found to have adopted collective measures, they helped in evacuating affected members; provided temporal accommodation for affected members or did general cleaning and cleared choked gutters. It was again identified that, even though none of the communities had a standing community flood emergency team, 99% of the household sampled think it is necessary to have one in their communities. The feasibility however is doubted by some of the community leaders and departmental heads on the basis of lack of funds to remunerate the members of the team.

5.2.6 Institutional Flood Adaptation

From the study, it is revealed that majority of households who are hit by floods report the cases to the NADMO and their respective Assemblymen; just a few report to the Town and Country Planning Unit in the Municipality. Also, even though majority of households who report flood cases indicated that they receive assistance from the institutions they report to, the assistance always came in the form of provision of relief items and provision of emergency evacuation services which were mostly found to be highly defective. The implication is that, institutional planned adaptations which were recommended by IPCC (2001) and World Bank & GFDRR (2012) have not been adequately exploited to address floods in the study communities.

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5.2.7 Households' Flood Mitigation Measures

The study further revealed that greater proportion (84%) of households sampled for the study have adopted some measures to mitigate the future occurrence of floods. These came in various dimensions; prominent among them however were the construction of drains around buildings; construction of flood protection walls and clearing of choked gutters amid other mitigation measures such as raising doors and window levels; installation of pipe outlets; elevation of building foundation; construction of flood diversion trenches among others. Again, majority of those who have not installed any mitigation measures explained that, it is because they did not have enough financial resources to do that and the others claimed there was nothing they could do due to the nature of the land. Among those who have installed mitigation measures, about 61% claimed they have seen some successes with their mitigation which primary came in the form reduction in the level of destruction caused by floods, and just a few have seen a reduction in the current occurrence of floods.

Furthermore, the study revealed that, even though floods remain menace in the study communities, just about 37% of respondents have plans to relocate to other communities. The other 63% have no plans to relocate on the basis that, they could not leave their own properties to settle elsewhere; some did not have enough financial resources to facilitate relocation; others did not have anywhere else to go; some claimed it is because they have seen reduction in the recent occurrence of floods and others have confidence that flood menace can be solved.

Also, among all the households that were sampled for the study, only 2% have subscribed to flood insurance policy to increase their resiliency against floods. The other 98% have not subscribed to any insurance policy; however, further enquiries revealed that majority of them will be willing to subscribe if they get the opportunity.

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5.2.8 Community Flood Mitigation Measures

The study revealed that, even though it is not so prominent for all the study communities, some community members in the study communities embark on collective community action to mitigate floods. Among the communities actions taken were desilting choked gutters; creating flood diversion trenches; embarking on community clean-up exercise and embarking on flood awareness campaigns. However the study further showed that several factors such as the feeling that mitigation is the sole responsibility of government; lack of cooperation among community members; lack of strong leadership and the individualistic attitude of some community members are among the reasons why some communities have not come together to mitigate floods.

5.2.9 Institutional Flood Mitigation Measures

The results of the study showed that institutional mitigation measures in the study communities have not been adequately exploited. Besides flood awareness campaigns which majority of respondents attested that NADMO has been doing, the actual activities of government and other institutions towards flood mitigation have not been visible in all the study communities. The study also revealed that, the few institutional mitigation measures installed have generally not been successful, mainly because they were either not done timely, not done regularly, not adequately monitored, not completed or community members were not involved in the installation and maintenance. Findings from the key informant interviews however revealed that plans were ongoing to redesign the drainage systems for the entire municipality. Beside, some contracts have been awarded for works to be carried out on the roads and drainage system in Tse-Addo and for the construction of storm drains in Kenan Factory.

The study also found that, majority of households in the study communities will be willing to collaborate with government to install flood mitigation measures. Even though just about 32%

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will be willing to support financially, others will be willing to offer free labour, participate in clean-up exercise, assist in flood awareness campaigns and provide necessary information need from the ground.

5.2.10 Constraints in Households Flood Adaptation

The study identified that, most of the households sampled for the study, face some challenges in installing effective flood adaptation measures. Notable among the constraints identified were lack of financial resources; lack of cooperation among community members and the reckless behavior of some community members such as the habit of some community members to deliberately throw rubbish into drains whenever it rains.

5.2.11 Constraints to Households Flood Mitigation

Similarly, the study revealed that most of the households are faced with couples of mitigation challenges. Among those identified were inadequate financial resources for households to finance flood mitigation; lack of cooperation among community members; reckless attitude of some community members; lack of support from the government and lack of relevant skills to install appropriate mitigation. At the community and institutional levels, lack of funds and cooperation from community members were the main constraints identified. Also inadequate training for the staff of NADMO was identified as a major constraint on the effective operation of the unit.

5.2.12: Reflection on Conceptual Framework

The conceptual framework was very helpful in all the stages of the study. The comprehensive nature of the framework provided sufficient guide in achieving all the research objectives as it was very instrumental in designing the research instruments for the study. This notwithstanding,

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the framework could be more helpful if it is expanded to touch extensively on the financial aspect of flood adaptation and mitigation since it was revealed that, inadequate financial resources is dominant factor impeding the efforts of households and other stakeholders to address flood menace in the study communities.

5.3 Conclusion

This study set out to examine the adaptation and mitigation strategies adopted by households and other stakeholders for addressing perennial flooding in the flood-prone communities in the La Dade-Kotopon Municipality. Using mixed method, the study explored the causes of floods in flood-prone communities; the effect of floods; the adaptation and mitigation measures adopted by households, the communities, government and other institutions to address the perennial occurrence of floods; the effectiveness of flood adaptation and mitigation strategies and the constraints to flood adaptation and mitigation. From the study, it was established that perennial flooding is a major challenge facing most of the households in the study communities. It has posed several detrimental effects on the residents including loss of lives, inflicting physical injuries on people; destruction of household buildings and properties; outbreak of flood-induced diseases such as malaria and cholera; pollution of the environment; and causing erosion among others. It was also established that flood incidences in the study communities are mostly caused by anthropogenic factors, notably lack of drains, building on waterways, choked drains, defective drainage design, congested settlement with poor layout, and poor enforcement of settlement regulations. The study also revealed that contrary to the recommendations made by World Bank & GFDRR (2012) for integrated urban flood risk management which should involve multiplicity of stakeholders, flood adaptation and mitigation measures in the study communities have usually been dominated by individual household efforts which are usually woefully insufficient to

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address flood disaster. Community collective efforts towards flood management have not yet been adequately exploited in all the communities. Besides, government and other institutions have also not been very proactive in their role to mitigate floods in the study community. Finally, the study also established that, household flood adaptation and mitigation have been confronted with several challenges including insufficient funds, lack of cooperation among community members and among stakeholders, reckless behavior of some community members; lack of support from the government and other stakeholders.

5.4 Recommendations

5.4.1 Recommendations for Policy Purpose

Based on the findings of this study, the following recommendations are made

- **Expansion of the drainage system:**

  There is an urgent need by the municipal authority in collaboration with the central government to pay attention to the drainage systems in the communities. Urgent efforts should be made to expand the drainage system by constructing new storm drains and redesigning the existing ones to allow for free flow of flood water. Besides, the Kpeshie Lagoon should be dredged and be protected thereafter from encroachment to serve as a buffer for all the drains in the municipality.

- **Intensifying flood awareness campaigns and early warning signals:**

  There is also the urgent need to resource the NADMO unit in the municipality to step up with their flood awareness campaigns and early warning signals to save the community members from avoidable losses. Other media such as radio stations, television stations,

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information centers and social media platforms can be exploited to facilitate effective awareness campaigns.

- **Redesigning the indigenous communities:**

  Owning to the fact that most of the flood-prone communities are ancient communities and are hosting a lot of indigenous people, any attempt to relocate them will be opposed by the people. Therefore, rather than considering permanent relocation of the residents, the authorities should look at redesigning the layout of those communities to introduce some modern facilities such as roads and drains.

- **Regular fumigation of the communities:**

  Due to the fact that most of the communities experience inland floods which usually stagnate for a long time before draining, there is the need for regular fumigation of the communities to battle breeding of mosquitoes and other vectors, and hence reduce the possibility of outbreak of malaria and other flood-induced diseases which are prevalent during raining seasons.

- **Exploring collaborations with community members:**

  Since majority of the households indicated their willingness to collaborate with government and other institutions to battle floods, initiatives should be taken by the municipal authority and the Assemblymen to explore the various ways through which such collaborations can be established to ensure all-inclusive adaptation and mitigation measures.

- **Enforcement of building regulations:**

  The Town and Country Planning Department in the municipality should be very proactive in enforcing building regulations. The department should particularly embark

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on regular monitoring to ensure that people adhere to settlement regulations, and also to help in early identification of illegal developments for necessary actions to be taken quickly.

- **Exploring flood insurance subscription:**

  Considerations should be given to idea of flood insurance subscription for households. Effort should be made to explore the best possible ways to go about it to help the community members to benefit from it.

- **Establishment of flood emergency team:**

  The authorities (particularly NADMO) should give some considerations to establishing community flood emergency teams for all the communities. Their presence in the communities will contribute greatly in providing quick emergency evacuation services for flood victims to help reduce the magnitude of the losses they incur.

5.4.2 Recommendations for Future Research

- Future research can be carried out to explore in details the idea of flood insurance subscription. This can help to address the doubts about its feasibility and how it can be used as efficient tool for increasing the resiliency of the community members towards floods.
- Also future research can be carried out to explore the various dimensions in which stakeholders can collaborate to ensure effective and all-inclusive flood mitigation. This will help to forge some understanding among stakeholders in combating floods.

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APPENDIX A: QUESTIONNAIRE FOR HOUSHOLD SURVEY

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH,

UNIVERSITY OF GHANA

"ASSESSING ADATATION AND MITIGATION STRATEGIES TO PERRENIAL URBAN FLOODING: A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LA DADE-KOTOPON MUNICIPALITY"

This questionnaire is designed to solicit your views on flood adaptation and mitigation measures by your household, community, government and other organizations on flood situation in your community. The research is conducted solely for academic purposes, and the information generated will be treated as such with utmost confidentiality. You can contact me on 0242075234/ for further clarification.

Below are series of questions which require your responses. There are no right or wrong answers to these questions. You should please answer as honestly as possible.

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

1. Community …….
2. Sex of Respondent …… 1. Male [ ] 2. Female [ ]
3. Age of respondent ……..
4. Educational Level of Respondent.

   1. None [ ] 2. Primary [ ] 3. JHS [ ] 4. SHS [ ] 5. Tertiary [ ]
5. Religion ……..
6. Sex of household head 1. Male [ ] 2. Female [ ]

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7. Occupation of the household head ……..

8. Household size ……

9. Household average monthly income (GH¢)…….

   1. GH¢ 100-500 2. GH¢ 600- 1000 3. GH¢ 1,100 – 1500

   4. GH¢1600-2000 5. Above GH¢ 2000

10. Highest educational level obtained in the household

    1. None [ ] 2. Primary [ ] 3. JHS [ ] 4. SHS [ ] 5. Tertiary [ ]

11. Number of years household has lived in this community ……

12. Nature of building

    1. Sandcrete building [ ] 2. Brick building [ ] 3. Mud house [ ]

    4. Wooden building [ ] 5. Others, specify

13. Number of years household has lived in this house/building ……

14. Residential Status: 1. Owner of the building [ ] 2. Tenant [ ] 3. Relative to owner [ ]

    4. Caretaker [ ] 5. Other, specify ……

SECTION B: OCCURRENCE OF FLOODS

15. Has your household ever experienced floods in this community?

    1. Yes [ ] 2. No [ ]

16. If yes, how many times has your household been flooded since you started staying in this community? 1. Once [ ] 2. Twice [ ] 3. Three times [ ] 4. Four our times [ ]

    5. Five times [ ] 6. Six times [ ] 7. Seven times [ ] 8. Other, specify ……...

17. If yes, when was the last time you experienced floods?

    1. Between 1 – 6 months ago [ ] 2. Between 7 – 11 months ago [ ]

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3. One year ago [ ] 4. Two years ago [ ] 5. Three years ago [ ]

6. More than Three years ……

18. Have you witnessed floods destroying property and causing problems in this community before? 1. Yes [ ] 2. No [ ]

19. Can you recall the number of times and which months floods occurred in this community within the following years?

YEAR	NUMBER OF TIMES FLOODS OCCURRED	MONTHS FLOOD OCCURRED	CANNOT RECALL
2016			
2015			
2014			
2013			

20. What kind of floods does your community often experience?

1. Riverine floods [ ] 2. Inland/areal floods [ ] 3. Flash floods [ ]

4. Coastal floods [ ] 5. Other specify……..

SECTION C: CAUSES OF FLOODS

21. In your view what do you think are the major causes of floods in your community? Are the floods in your community caused by:

No.	Major Causes of Floods	Yes	No	Can't tell
a.	Lack of drainage facilities?			
b.	Choked drains?			
c.	Poor drainage design and construction?			
d.	People building on waterways			
e.	Heavy rains			
f.	Disregard for building codes?			
g.	Congested settlement/poor layout?			
h.	Water-log area?			
i.	Impervious land surface?			
j.	Improper solid waste disposal?			
k.	People building on reclaimed land?			
l.	Activities of other communities?			

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m.	Act of God/gods?			
n.	(Other)			

SECTION D: EFFECTS OF FLOOD

22. Has your household ever been affected by flood?

1. Yes [ ] 2. No [ ]

(If no, skip to question 27)

23. *Answer '**Yes**' or '**No**' to the following effects of flood on households. **Tick 'Yes'** if the household or a member of the household has ever experienced such effect and **tick 'No'** if household has not experienced such effect. Tick **'don't remember'** if you cannot recall.*

No.	Effect of floods on household	Yes	No	Don't Remember
a.	Loss of a household member			
b.	Incurred Physical injuries			
c.	Loss or destruction of household items (eg. TV, fridge, furniture)			
d.	Acquisition of flood-induced diseases (eg. Malaria, cholera, etc.)			
e.	Loss of livelihood/income generating activities (eg. Home-based business)			
f.	Destruction of building and walls			
g.	Disruption in supply of utility services			
h.	Pollution of the environment			
i.	Erosion around vicinity			
j.	Frustrations and general inconvenience			

SECTION E: HOUSEHOLD ADAPTATION STRATEGIES TO FLOODS

24. What did your household do to enhance your preparedness whenever you anticipated that floods were likely to occur on a particular day?

……
……

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25. What did you do during the time that floods actually occurred to ensure the safety of members and household properties?
……
……
26. What recovery measures did your household put in place after flood events?
……
……

SECTION F: HOUSEHOLD MITIGATION STRATEGIES TO FLOODS

27. Have you put in any measure to mitigate the future exposure of household members and your properties against floods?

1. Yes [ ] 2. No [ ]

(If no skip to question 31)

28. Indicate which of the following measures you have installed to minimize the occurrence of floods around your building?

		Installed	
No.	**Measure**	**Yes**	**No**
a.	Construction of drains around your building		
b.	Building flood resistance walls		
c.	Clearing choked gutters around your building		
d.	Raising doors and window levels		
e.	Elevation of house foundation		
F	Constructing flood diversion trenches		
g.	Blocking flood water flow with sandbags		
h.	Installation of pipe outlets to drain water away from the building		
Other			

29. In your view have your mitigation measures been successful in preventing floods?

1. Yes [ ] 2. No [ ]

30. If yes, what major changes have you seen now?

1. Reduction in the occurrence of floods [ ]

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2. Reduction in the level of destruction caused by floods [ ]

3. Other, specify ……..

31. If no, what might be the reason?

……
……

32. If no, why haven't you done anything to protect yourself and your properties against floods? ***(Refer to question27)***

……
……

33. Does your household have any plans of relocating to another community where there are no floods? 1. Yes [ ] 2. No [ ]

34. If no, why haven't you considered relocating?

……
……

35. Has your household subscribed to any flood insurance policy to ensure the security of your properties? 1. Yes [ ] 2. No [ ]

(if no, move to question 37)

36. If yes which items in your household have you insured?

1. The building 2. Furniture 3. Electronic devices

4. Others, specify…….

37. Which insurance company do you hold your flood insurance policy with?

……

38. If No, will you want to insure yourself and your property against floods when given opportunity? 1. Yes [ ] 2. No [ ]

SECTION G: COMMUNITY ADAPTATION STRATEGIES TO FLOODS

39. Have you witnessed any action taken by the community during an event of flood to reduce the risk of disaster caused to members? 1. Yes [ ] 2. No [ ]

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40. If yes, what actions do community members usually take during event of floods to help members from the risk of disaster?

.....
.....

41. Does your community have any flood emergency standby team to provide rescue services to members during the event of flood?

1. Yes [ ] 2. No [ ] 3. Don't know [ ]

42. If no, do you think it will necessary to have one in your community?

1. Yes [ ] 2. No [ ]

SECTION H: COMMUNITY FLOOD MITIGATION MEASURES

43. Have community members made any efforts as a group to prevent future occurrence of flood? 1. Yes [ ] 2. No [ ]

44. If yes, what efforts have been made?

……
……

45. If No, why hasn't the community organize itself to prevent floods?

……
……

SECTION I: INSTITUTIONAL FLOOD ADAPTATION MEASURES

46. Do you report incidence of floods to any authority?

1. Yes [ ] 2. No [ ]

47. If yes, which authorities do you report to? (select all applicable)

1. NADMO [ ] 2. Assembly man [ ] 3. Town and Country Planning [ ]

4. Others (Please specify……

48. If no, why don't you report to the authorities?

……
……

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49. Do you receive any assistance when you report?

1. Yes 2. No

50. What help are usually offered to you?

1. Provision of emergency evacuation [ ] 2. Provision of relief items [ ]

3. Others, Specify ……..

SECTION J: INSTITUTIONAL MITIGATION MEASURES

51. What measures have you seen government (both local and national) or any other institution put in place in your community to mitigate floods?

No.	Mitigation Measure	Yes	No	Don't know
a.	Constructing drains			
b.	De-silting drains			
c.	Clearing waterways			
d.	Public education (awareness campaigns)			
e.	Issuing early warning signals			
f.	Enforcing building codes			
g.	Preventing authorized building on waterways			
h.	Demolishing unauthorized structures on waterways			
i.	Solid waste collection and management			
j.	Protecting wetlands and floodways			
Other				

52. Have the mitigation measures put in place by government and other organizations been successful? 1. Yes [ ] 2. No [ ]

(if no skip question 53)

53. If yes, what changes have you seen recently?

1. Reduction in the occurrence of floods [ ]

2. Reduction in the level of destruction caused by floods [ ]

3. Other, specify ……..

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54. If No, what may be the reason?

1. Not done timely 2. Was not completed 3. Not done regularly

4. Not done properly 5. Ineffective monitoring

6. Community members are not involved [ ] 7. Other, specify ……

55. In your view, what do you think government and other institutions should do to minimize the occurrence and impact of floods in your community in the future?

(Select as many as are applicable)

1. Construction of drains [ ] 2. De-silting of drains [ ] 3. Clearing of waterway [ ]

4. Enforcement of building codes [ ] 5. Issuing early warning signals [ ]

6. Demolishing unauthorized structures built on waterways [ ]

7. Public education [ ] 8. Helping members who are at high risk to relocate to safer communities [ ] 9. Others, specify……..

56. Will you be willing to collaborate with government to prevent floods in your community?

1. Yes [ ] 2 No [ ]

57. Will you be willing to contribute financially to flood adaptation and mitigation measures by government? 1. Yes [ ] 2 No [ ]

58. In what other way will you be willing to assist government to deal with floods in your community?

……
……

SECTION K: CONSTRAINTS TO HOUSEHOLD FLOOD ADAPTATION

59. Are there challenges you encounter in your effort to put in flood adaptation measures?

1. Yes [ ] 2. No. [ ]

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60. If yes, what major challenges have your household face in adapting to flood?

……
……

SECTION M: CONSTRAINTS TO HOUSEHOLD FLOOD MITIGATION MEASURES

61. Are there any challenges you encounter in your efforts to put in measures to prevent floods? 1. Yes [ ] 2 No [ ]

62. If yes, what challenges do you encounter?

1. Inadequate financial resource [ ]
2. Lack of co-operation from other community members [ ]
3. Reckless behavior of other community members [ ]
4. Lack of support from government/city authorities [ ]
5. In adequate skills to install appropriate flood management systems [ ]
6. Others, specify ……

63. What do you suggest should be done to address the challenge you encounter in mitigating floods?

……
……

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APPENDIX B: INTERVIEW GUIDE FOR MUNICIPAL NADMO DIRECTORATE, LADMA

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH,

UNIVERSITY OF GHANA

ADAPTATION AND MITIGATING STRATEGIES TO URBAN PERENNIAL FLOODING: A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LADMA

A. BACKGROUND INFORMATION

Position of Office: ……

Date and Time of Meeting ……..

B. CHECK LIST OF ISSUES TO BE DISCUSSED

1. Detail description of flood situation in flood-prone communities in the Municipality
2. Views on causes of floods in the flood prone communities
3. Report on how floods affect community members
4. The role of the NADMO in flood prevention
5. Major policies, programs, laws, activities or projects undertaken by NADMO in the past to deal with floods in the flood prone communities.
6. Assessment of Effectiveness of the actual activities of the institution in dealing with floods
7. Assessment of Collaboration with other institutions (public and private)
    a. Expected collaboration
    b. Actual collaboration

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8. Assessment of community collaboration with the NADMO in dealing with floods in the communities
    a. Community leaders
    b. Community members
9. Views on what the NADMO expect from residents of flood prone communities to help deal with the flood menace
10. Existence of stand-by flood emergency team in attending to flood victims in the municipality
    a. What is the composition of the flood emergency team?
    b. Records past activities of the team in attending to flood victims?
    c. Challenges faced by the flood emergency team
11. Sources of finance of the institution in flood management activities.
    a. Are there any budgetary constraints?
12. Major Challenges of the institution in dealing with floods.
13. Recommendations

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APPENDIX C: INTERVIEW GUIDE FOR TOWN AND COUNTRY PLANNING DEPARTMENT, LADMA

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH,

UNIVERSITY OF GHANA

ADAPTATION AND MITIGATING STRATEGIES TO URBAN PERENNIAL FLOODING: A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LADMA

A. BACKGROUND INFORMATION

Date and Time of Meeting ……..

Position of Officer ……

B. CHECK LIST OF ISSUES TO BE DISCUSSED

14. Detail description of flood situation in flood-prone communities in the Municipality
15. Views on causes of floods in the flood prone communities
16. Assessment on how floods affect community members
17. Assessment of the role of town and country planning Department in flood prevention
18. Major policies, programs, laws, activities or projects undertaken by the institution in the past to deal with floods in the flood prone communities
19. Assessment of Effectiveness of the actual activities of the institution in dealing with floods
20. Assessment of plans underway to mitigate floods
21. Existence of settlement planning code for the identified flood prone communities
    a. Are the code effectively enforced?
    b. Do community members comply or disregard the settlement planning code?
    c. What disciplinary measures has the TCPD instituted in ensuring compliance?

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d. Any record of such disciplinary measure used in the past?

22. Assessment of community collaboration with the TCPD in dealing with floods

    a. Community leaders

    b. Community members

23. Assessment of other institutions/units (public and private) that collaborate with the TCPD in planning to minimize effects of floods in flood prone communities in the municipality.

24. Assessment of sources of finance of the TCPD in its programs and activities to minimize floods

25. Major challenges of the TCPD in dealing with floods

26. Recommendations.

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APPENDIX D: INTERVIEW GUIDE FOR MUNICIPAL ENGINEERING, LADMA

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH, UNIVERSITY OF GHANA

ADAPTATION AND MITIGATING STRATEGIES TO URBAN PERENNIAL FLOODING: A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LADMA

A. BACKGROUND INFORMATION

Position of Office: ……

Date and Time of Meeting ……..

B. **CHECK LIST OF ISSUES TO BE DISCUSSED**

1. Flood prone-communities in the municipality
2. Views on factors accounting for the flooding
3. Assessment of the nature drainage system in the communities
    a. Availability
    b. State/functionality
4. Assessment of the topography of the land and the nature of soil in the flood prone communities
5. The role of the municipal Engineering Department in mitigating floods in the municipality
6. Major activities or projects undertaken by Department in the past to deal with floods in the flood prone communities.
7. Assessment of Effectiveness of the actual activities of the institution in dealing with floods.

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8. Assessment of plans put in place by the department to mitigate the future occurrence of floods in the flood prone communities
9. Assessment of Collaboration with other institutions (public and private)
    a. Expected collaboration
    b. Actual collaboration
10. Assessment of community collaboration with the department in dealing with floods in the communities
    a. Community leaders
    b. Community members
11. Major challenges confronting the department in its activities to mitigate floods
12. Recommendation

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APPENDIX E: INTERVIEW GUIDE FOR MUNICIPAL PLANNING UNIT, LADMA

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH, UNIVERSITY OF GHANA

ADAPTATION AND MITIGATING STRATEGIES TO URBAN PERENNIAL FLOODING: A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LADMA

A. BACKGROUND INFORMATION

Position of Office: ……

Date and Time of Meeting ……

B. CHECK LIST OF ISSUES TO BE DISCUSSED

1. General knowledge on flood prone communities in the municipality
2. Views on causes of floods in the flood prone communities
3. Report on how floods affect community members
4. Assessment of how floods affect development in the municipality
5. Assessment of the role of the Development planning unit in dealing with floods
6. Major policies, programs, laws, activities or projects undertaken by the municipality in the past to deal with floods in the flood prone communities.
7. Assessment of whether or not the ordeals of the flood prone communities are captured in current medium term plan of the assembly?
8. Assessment of the extent to which the perennial flood issues in the medium term plan were implemented
    a. Success level
    b. Challenges in implementation

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9. Assessment of the institution that collaborate with the Development Planning unit in dealing with floods.
    a. The degree of success of the collaboration
10. What other institution does the municipality expect to step in to help in addressing flood issues in the municipality?
    a. What exactly are expected from those institutions
11. Assessment of community collaboration with the Assembly in dealing with floods
    a. Community leaders
    b. Community members
12. Views on what the assembly expect from community members to help deal with floods.
13. What major challenges does the assembly encounter in dealing with flood issues in the municipality?

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APPENDIX F: INTERVIEW GUIDE FOR MUNICIPAL FINANCE AND BUDGET DEPARMENTS, LADMA

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH,

UNIVERSITY OF GHANA

ADAPTATION AND MITIGATING STRATEGIES TO URBAN PERENNIAL FLOODING: A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LADMA

A. BACKGROUND INFORMATION

Position of Office: ……

Date and Time of Meeting ……

B. CHECK LIST OF ISSUES TO BE DISCUSSED

1. Reports of flood cases received by the department
2. Knowledge of flood prone communities in the municipality
3. Assessment of any budgetary allocation by the municipality to deal with floods in the flood prone communities.
4. Past records of budgetary allocations by the municipality in dealing with floods (For the past two years)
    a. Budget (Amount)
    b. Actual expenditure (Amount)
5. Knowledge on exact flood management activity the allotted money was used for.
6. Which institution or Department used the money?
7. Assessment of the degree of success following the flood management activity budget was expended.

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8. Assessment of challenges confronting the municipality in expending on flood management programs and activities.
9. Are there any flood management reports or programs pending as a result of budgetary constraints?
10. Assessment of sources of revenue for the past expenditure on flood prevention management activities of the municipality.
11. Assessment of the institutions and organizations (public and private) that collaborate with the municipality to finance flood management programs.
12. Assessment of any attempt by the assembly to mobilize resource from the community members to embark on flood adaptation and mitigation programs in the communities
13. Recommendations.

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APPENDIX G: INTERVIEW GUIDE FOR ASSEMBLY MEN

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH,

UNIVERSITY OF GHANA

ADAPTATION AND MITIGATING STRATEGIES TO URBAN PERENNIAL FLOODING: A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LADMA

A. BACKGROUND INFORMATION

Name of Respondent……

Position of office ……..

Date and time of interview …….

Contact No.……...

B. CHECK LIST OF ISSUES TO BE DISCUSSED

1. Detail description on flood situation in the community
2. Views on factors accounting for floods in the community
3. Account on how floods have affected community members
4. The role of the office in dealing with floods in the community
5. Question on whether or not the community has put in place any measure to deal with floods
6. Exact adaptation and mitigation measures the community has adopted to prevent floods
7. Success of community flood adaptation and mitigation measures
8. Collaborating institutions (public and private) in dealing with floods in the flood-prone communities
9. Assessment of the extent of the collaboration

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10. Sources of finance for community flood management measures

11. Existence of stand-by flood emergency team in the community

12. What is the composition of members

13. Major constraints that confront the community in flood adaptation and mitigation

14. Recommendations

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APPENDIX H: INTERVIEW GUIDE FOR COMMUNITY MEMBERS

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH,

UNIVERSITY OF GHANA

ADAPTATION AND MITIGATING STRATEGIES TO URBAN PERENNIAL FLOODING:

A CASE STUDY OF FLOOD PRONE COMMUNITIES IN LADMA

A. BACKGROUND INFORMATION

Name of Respondent……

Date and time of interview ……..

Contact No……...

B. CHECK LIST OF ISSUES TO BE DISCUSSED

1. Number of years of living the community
2. Detail experience with floods in the community
3. Views on factors accounting for floods in the community
4. Account on how floods affect household
5. Account on how floods have affected community members
6. General adaptation strategies of household
7. General household mitigation strategies
8. Assessment of household adaptation and mitigation financing
9. Flood recovery strategies of households
10. General adaptation strategies of the community
11. Flood recovery strategies of community members

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12. General mitigation strategies of community members to prevent the future occurrence of floods
13. Success of community flood adaptation and mitigation measures
14. General views on the following activities of government in dealing with floods
    a. Building of drainage
    b. Enforcement of building codes
    c. Solid waste collection and disposal
    d. Public education
    e. Early warning signals
15. Views on general community collaboration with government in dealing with floods
16. Views on household support for government adaptation and mitigation programs
17. Views on household flood insurance