REGIONAL INSTITUTE FOR POPULATION STUDIES
UNIVERSITY OF GHANA, LEGON

ASSESSING THE IMPACT OF FLOOD EXPERIENCE ON HOUSEHOLD LIVELIHOOD IN SELECTED COMMUNITIES WITHIN THE GREATER ACCRA METROPOLITAN AREA (GAMA)

BASIL TUNGBANI

10523796

THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF ARTS IN POPULATION STUDIES DEGREE

JUNE, 2021

DECLARATION

I, Basil Tungbani, hereby declare that this dissertation is my research work submitted for the award of Master of Arts degree in Population Studies and that, to the best of my knowledge it contains neither in part nor in whole materials previously published by another person or materials which have been accepted for the award of any other degree by this or another university except where due acknowledgment has been made in the text.

11th June, 2021

Basil Tungbani Date

(10523796)

Student

ACCEPTANCE

This dissertation has been accepted by the Regional Institute for Population Studies (RIPS), College of Humanities at the University of Ghana, Legon, in partial fulfilment of the requirement for the degree of Master of Arts (MA) in Population Studies.

11th June, 2021

Dr. (Mrs.) Faustina Frempong-Ainguah Date

Supervisor

DEDICATION

To the inspiring efforts of my dad, mum, and siblings.

ACKNOWLEDGEMENT

I am grateful to the almighty God for seeing me through the beginning to the end of this stage of my academic journey. I am extremely grateful to my supervisor Dr. (Mrs.) Faustina Frempong-Ainguah who diligently gave me guidance and support right from the beginning of the study to the end. This study would not have been accomplished without her professional and intellectual input.

I also acknowledge the Cities and Climate Change Project coordinators at the Regional Institute for Population Studies (RIPS) for permitting me to use the 2017 Cities and Climate dataset for my dissertation.

My sincere appreciation also goes to Dr. John Kusimi of the Department of Geography for his encouragement and assistance in securing accommodation on campus which enabled me to complete this work. I am very grateful.

Furthermore, heartfelt thanks to the entire faculty at RIPS for their contributions and constructive criticism which helped me to shape the work. To the RIPS Ph.D. students who constantly called to check up on the progress of my work especially David Adumbire and Christiana Adu, I am grateful. To Martin Agyekum and Charles Asabre who availed themselves to my aid, thank you.

To my family for their constant support, encouragement, and prayers. A special appreciation goes to my uncles, Victor Tiher and Emmanuel Lombori, and their families for their encouragement and support. The generosity of all my extended family members is highly appreciated. Thanks for being there for me.

Finally, I want to acknowledge the efforts of my friends; Ernest Ayumu Teye, Yowome Kumasi, Samuel Duku, Valentine Anaba & Reginald Dassah who in one way or the other also contributed to the success of this dissertation. To you all, I say Thank you.

ABSTRACT

Flood experience and household livelihood disruption remain a global challenge. This is most severe in developing countries which still records very high cases of flood disasters. The study examined the relationship between flood experience and household livelihood outcomes in selected communities within the seven districts forming the Greater Accra Metropolitan Area (GAMA). Flood experience in the study was measured based on households' frequency of floods experienced occasionally, yearly, and seasonally. Household livelihood outcome was measured by a composite index score as livelihood disrupted. Bivariate and multivariate analyses were used to examine the relationship between flood experience and household livelihood outcomes. The 2017 Cities and Climate Change survey is the main data source of the study. The study used a sub-sample of 823 households that experience floods in the study area. A majority (78%) of the households were found to be experiencing flooding yearly and seasonally which indicates that floods experience among the study population was prevalent. Results from the analysis indicate that; flood experience, employment status, district of residence, the community of location, and household level of adaptation were statistically significant predictors variables on household livelihood disruption. However, educational attainment, wealth group, age, sex, marital status, household size, tenancy agreement, and the community level adaption outcome were not significant predictors of household livelihood disruption. The study, therefore, concludes that the entire study area is vulnerable to the occurrence of floods and recommends that interventions should be made by the individual, community, and government levels in mitigating flood disasters.

Keywords: Floods. Livelihood. Disruption. Adaptation. Vulnerability. Mitigation

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

UN-HABITAT	United Nations Human Settlements Programme
EPA	Environmental Protection Agency
GAMA	Greater Accra Metropolitan Area
NADMO	National Disaster Management Organization
FAO	Food and Agriculture Organization
DFID	British Department for International Development
ILGS	Institute of Local Government Studies
IIED	Intentional Infliction of Emotional Distress
NRDC	Natural Resources Defence Council
UNISDR	United Nations International Strategy for Disaster Reduction
OFDA	Office Of Foreign Disaster Assistance
CRED	Centre for Research on The Epidemiology of Disasters
EM-DAT	Emergency Events Database
MESTI	Ministry of Environment, Science, Technology, And Innovation
CSIFM	Climate-Smart Integrated Flood Management Frame

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

Globally, the relationship between flood experience and its impact on livelihood cannot be undermined. The world has recounted many disasters induced by both climatic and non-climatic factors including floods. Floods affect 2.5 billion people with nearly half a million casualties (Guha-Sapir & Ph, The numbers and trends, 2015), and about US$700 billion worth of property was destroyed in 2012 (Foresight, 2013).

Floods are sudden or catastrophic events that bring greater damage, such as; displacement of people, loss of lives, and property. Floods accounted for 40 percent of over 1000 disasters recorded between 2004 and 2008 (Costello et al. 2009). The United Nations Human Settlements Programme (UN-HABITAT, 2011), observed that floods account for nearly 84 percent of all disaster-associated casualties including deaths, injuries, and other damages (Doocy et al., 2013).

In recent times, the impacts of floods have had more negative effects on the social, economic, and cultural lives of people (Munich, 2002; Barrett et al., 2006; UN-HSBITAT, 2011). Barrett et al. (2006) noted that the prevalence and severity of flood disasters disrupted livelihoods particularly the poor with an estimated 240 million lives disrupted between 2000 and 2005.

In most urban areas of developing or least developed countries, poor residents are seen as the most vulnerable due to their low resilience capacity (UNDP, 2009). The rapid growth of population, coupled with fast urban sprawling, poor planning, lack of resources, and poverty, worsen the risk of urban areas to flood disasters (Songsore et al., 2009). In unplanned urban areas, buildings are built in an unorganised manner that acts as a blockage for the easy flow of water and can induce

flooding due to an excessive accumulation of storm waters when it exceeds its banks (Ouma & Tateishi, 2014).

Though persons residing in the same community may be exposed to the risks of flood disasters, the impact of floods on their livelihoods may differ due to the variation in their livelihood strategies (Koks et al., 2015) and the activities that households adopt to mitigate floods (Garbero & Muttarak, 2013). Similarly, the unequal livelihood disruption varies because of the activities that households adopt to mitigate floods (Garbero & Muttarak, 2013). This study seeks to assess the impacts of flood experience on household livelihood and the adaption strategies that could be implemented to remedy the intermittent situation.

1.2 Statement of the problem

Floods are a major problem in most developing countries. Sub-Saharan Africa, between 1997-2008 recorded over 166 urban disasters in 28 cities (Songsore et al., 2011). From 1900 to 2006, 20,000 fatalities with nearly 40 million injuries of flood disasters were recorded in African cities and nearly t four billion ($4.0 billion) dollars worth of damages were estimated (Mulungeta et al., 2007). Floods are among some of the recurrent events in Africa and contribute immensely to the loss of life and property (Songsore et al., 2011). A study conducted by Amoako et al. (2015) in Ghana, observed that most of the flood disasters in the country affected mostly the poor and the vulnerable in society. In Ghana, the reoccurrence of flood events most especially in the cities requires urgent attention in finding a permanent solution to these floods' events. This, therefore, calls for the involvement of many stakeholders and non-governmental organizations to remedy the effect of flood experiences on household livelihood disruption among people living in flood-prone communities (Mulungeta et al., 2007). The attention to address this menace could be both policy

and research. In Ghana, however, policy regulations regarding urban planning are latent and scholarly works on flood impacts are patchy and scanty. In this view, Rain et al. (2011), in their recent study, suggested that the local authorities must prioritize and identify the casual elements of these flood events and their impacts on the socio-economic and demographic characteristics of humans.

Meanwhile, the severity and impact of floods vary between population subgroups. This could be a result of the degree of vulnerability and the capacity to cope with such disasters. Therefore, to understand floods' impact and adopt mitigation strategies, it is important to recognize the unequal impacts of floods on various social groups (Abeka, 2014).

Undoubtedly, floods had a serious effect on the living standards of people in the country, particularly in the urban context where housing infrastructure is poor and congested. According to Tschakert et al (2010), Ghana is placed high among African countries that are most exposed and vulnerable to risks associated with environmental hazards. The occurrence of floods in Ghana is more intense in the coastal belt and northern savannah.

Historically, since the 1930s, concerns have been heightened about urban flooding especially in Accra the capital of Ghana (Karley, 2009) with major flood disasters recorded in 1973, 1986, 1995, 2001, 2002, 2010, 2011, and 2015 (Asumadu-Sarkodie, Owusu & Rufangura, 2015). A report on natural disasters and hazards in Ghana rated flood as the second after epidemics that have led to the loss of lives. Between the period 1968-2015, about 415 people out of 3.86 million people have lost their lives to flood. On 3rd June 2015, an explosion at a fuel station in Accra accompanied by floods became the worst climate disaster to have hit the country in the most recent time. The flood led to a loss of about 152 lives and properties running into millions of dollars (Asumadu-Sarkodie

et al., 2015). Other cost of the flood impacts particularly social cost which statistical aggregation cannot be made is even worse.

Between 1955 and 1997 property worth over US$30 million was destroyed, 100 lives lost and 10,000 people were rendered permanently homeless (Gyau-Boakye, 1997). In the year 2009, the National Disaster Management Organisation of Ghana (NADMO) estimated the cost of managing flood damage has increased from US$ 2 million to US$ 4million per major flood event over the last decade. According to Karley (2009), the total value of assets at risk from flooding in Accra now exceeds US$ 6 million per year. This saw an increase from US$500,000 recorded in 2007 by the Ghana National Disaster Management Organisation (NADMO, 2009). In 2008, it was estimated that flooding in July and August caused more than US$1 million worth of damage in the city. This shows an approximately 100 percent increase in the cost of damage from flooding per year. Aside from these monetary costs of urban flooding, adverse impacts such as homelessness, the spread of diseases, and emotional trauma continue in communities for months and sometimes years (Karley, 2009).

Physical and economic costs of flooding such as inability to go to work increase the loss in productive hours, labour income losses, destruction and loss of services and businesses, damage and destruction of crops, and farmlands which ends up affecting the livelihoods of people. Though floods affect a cross-section of the income bracket, the poor are the most affected by the occurrences, partly because the majority of the urban poor reside in flood-prone areas such as floodplains, and this can be explained by their inability to afford decent housing in areas that are not flood-prone. Therefore, when flood events occur the majority of the affected lose their source of livelihood because they are not able to withstand the shock due to their low resilience level (Hallegatte & Erman, 2018). This circumstance worsens the living conditions of the affected and

subjects them to engage in activities that increase their susceptibility to other forms of risks such as armed robbery, prostitution, drug dealing, etc.

Flowing from above, it is clear that the experience of flood disasters in the country especially in urban Accra is not a new phenomenon. However, efforts to address and manage urban floods in Ghana are inadequate. Government resources in the form of reliefs to affected persons often arrived too late when the harm has already been caused. Aside from the social, physical, and economic impact of the flood phenomenon, it has a cascading effect on the development of the country. This is because funds meant for other developmental projects are often used to assist flood victims to regain their livelihood. One major challenge of research in this area in Ghana, however, is the failure to assess flood impact at the household level who are the direct victims of such events. Meanwhile, an understanding of the impacts of flood experience on household livelihood disruption can be a panacea flood risk. It could also provide knowledge of population vulnerability to flooding risk. It even serves as a drawing board for designing appropriate mitigation and flood vulnerability mapping. This study sought to fill this gap by exploring the impacts of flood experience on household livelihood disruption in 14 selected communities in the Greater Accra Metropolitan Area (GAMA). These communities were selected as part of a larger research project conducted by the Regional Institute for Population Studies which data is the main source of the current study. The communities were selected based on three criteria. First, the community is an urban community and forms part of the GAMA area. Second, a coastal community hence prone to flood. And third, has experienced frequent floods.

Obtaining household characteristics for these communities, the current study examined the relationship between the severity of the flood experience in GAMA and its associated effect on population livelihood.

1.3 Rationale of the study

Flood events have been one of the detrimental issues to the Ghanaian society. Flood events have caused the loss of many lives and a huge worth of property. Flood disasters among many disasters the country often experiences are human-induced that can be reduced if not prevented entirely. Though there are guidelines published by the United Nations (UN) on reducing flood losses, domestic institutions such as the National Disaster Management Organization (NADMO) which is mandated to mitigate disasters (especially human-induced) must also come out with policies and strategies that fit the Ghanaian context in addressing flood disasters.

The recent consequences of climatic conditions impact on flood experience coupled with human-related causes among countries with high adaptive capacity remain vulnerable (Confalonieri et al. 2007). The heterogeneity of urban poor neighbourhoods, coupled with the density of the population, makes it relevant to examine the relationship of flood experience on household livelihood. To help contextualize the challenge of floods to lives, there is, therefore, the need for a study that would analyse and explore the impacts of flood experiences on the livelihood of respondents in the Greater Accra Metropolitan Area (GAMA). Therefore, the results of the study will be useful in providing information to the relevant stakeholders in flood risk management. The study will also serve as reference material for academics, researchers, and practitioners of disaster management.

1.4 Research questions

i. What is the prevalence and severity of flood experience among households in selected communities within the Greater Accra Metropolitan Area (GAMA)?

ii. Is there a relationship between flood experience and household livelihood disruption in GAMA?

iii. What are the impacts of flood experience on livelihood disruption among the study population controlling for other factors?

1.5 Hypotheses of the study

i. Households who experience floods seasonally are more likely to have their livelihood disrupted compared to households who experience floods occasionally

ii. Households who were adapting at the household level are less likely to have their livelihood disrupted compared to households who were not adapting at the household level

iii. Respondents with below Junior High School level of educational attainment are more likely to have their livelihood disrupted compared to respondents with Senior High School or above educational level attainment

iv. Households in the poor wealth group are more likely to have their livelihood disrupted compared to households in the rich wealth group

1.6 Research objectives

The main objective of the study is to assess the impact of flood experience on livelihood disruption in selected communities within the seven districts of the Greater Accra Metropolitan Area (GAMA). The study is, however, guided by the following specific objectives:

i. To describe the prevalence and severity of household flood experience in the Greater Accra Metropolitan Area (GAMA)

ii. To assess the possible relationship between flood experience and livelihood disruption and other related factors

iii. To examine the possible net influence of flood experience on livelihoods disruption in selected communities within the GAMA

1.7 Definition of terms

1.7.1 Livelihood

Chambers and Conway (1992), defined livelihood as a system that comprises the capabilities and assets that are necessary for a means of living. The choice of the activities that are undertaken at the household level is referred to as the household livelihood strategy. A livelihood strategy includes not only activities that are generated for income but also involves the social and cultural choices of individuals (Ellis, 2000).

1.7.2 Flood

Flood refers to the temporary condition of the surface of a lake, river, or sea, in which the water level and/or discharge exceed a certain value, water thereby escaping from its normal confines (Mumuni, 2013). This, however, necessarily does not result in flooding (Munich-Re, 1997, cited in Mumuni, 2013).

1.7.3 Hazard

The United States Federal Emergency Management Agency (FEMA), defines a hazard as ‘‘events or physical conditions that have the potential to cause fatalities, injuries, property damage,

infrastructural damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss'' (Coppola, 2007: 24, FEMA, 1997, p.2).

1.7.4 Disaster

According to the United Nations International Strategy for Disaster Reduction (2004), a disaster is defined as ''a serious disruption of the functioning of a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its resources'' (UN/ISDR, 2004, p.9).

1.7.5 Vulnerability

The International Federation of Red Cross (2017), defines vulnerability as the diminished capacity of an individual or a group to anticipate, cope with, resist and recover from the impact of a natural or a man-made hazard. The concept of vulnerability is mostly associated with poverty (IPRC, 2017). In this study, vulnerability is defined as the potential for loss (human, physical, economic, natural, or social) due to flood events.

1.7.6 Adaptation

Adaptation refers to any variation that can increase a person's fitness in a specific environment; more simply it is the successful interaction of a population with its environment (Meyers and Bull, 2002, cited in Garcia de Leaniz et al. 2007).

1.8 Organization of the study

This study is structured into five (5) chapters. Chapter one presents the background to the study, the statement of the problem, justification of the study, research questions, objectives of the study,

definition of terms, and organization of the study. Chapter two presents a review of relevant literature to the study structured under different themes and study hypotheses. Chapter three entails the profile of the study area, study population, methodological intersections and data/information flow, data source, sample size and research design, measurement of the study variables, and methods of data analyses. Chapter four presents the findings and discussions of the study results. This chapter includes the prevalence of flood experiences, the severity of floods pattern livelihood disruption as a result of flood experiences, and calculated background characteristics of the households studied. This chapter also included the chi-square test of association between each of the independent variables and the dependent variable. Moreover, the chapter included discussions of the findings of the study based on the multivariate analysis. Finally, chapter five (5) presents the summary, conclusions, and recommendations arising from the study.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter reviews the relevant literature to the study and structured in the following thematic areas; the concept of livelihood, types of livelihood assets, flood disasters, causes of flood disasters, natural causes of flooding, human causes of flooding, extend of flood disasters, flood risk areas in GAMA, influence of flood experience on livelihood disruption, the role of government in flood impact on livelihood, the Sustainable Livelihood Framework and conceptual framework. The Sustainable Livelihood Framework is the theoretical underpinning that drives this study.

2.1 Concept of livelihood

The concept of livelihood has become an important tool for development practices and policies in the world today. Livelihood can be described as assets and activities required for a means of living (Chambers and Conway, 1992). According to FAO (2007), livelihood comprises the capabilities, assets, and activities required for a means of living. Chambers and Conway (1992) argued that livelihood is sustainable when it can cope with, and recover from, stress and shocks (like drought and flood) and enhance its capabilities and assets while not undermining the natural resource base. Sustainable livelihood approaches have been adopted by several development agencies, of which the British Department for International Development (DFID) is not an exception. In its framework, DFID includes five (5) assets to measure the concepts of livelihood outcomes – social, natural, physical, financial, and environmental assets.

2.1.1 Types of livelihood assets

First and foremost, social assets refer to status in society as well as access to extended family and other social networks. It also includes relationships of trust and reciprocity that facilitate cooperation, reduces transaction costs, and can provide the basis for informal social safety nets amongst poor people. Households with strong social ties can get assistance in the form of aid to enhance their livelihoods should they be exposed to flood disasters. In furtherance, households without strong social ties would not have the aid when challenged with flood disasters. Social assets are, therefore, vital in determining the capacity of households in responding to shocks due to flood disasters. Secondly, natural assets comprise natural resource stocks such as land and water resources which people can access and use to build their livelihoods. These types of resources are gifted by nature and only require the knowledge of man in extracting them. Thirdly, physical assets include shelter, tools, and equipment which may also be community-owned – for instance, road infrastructure. Furthermore, the financial assets include income and also access to credit investment. They may include available stock which can be held in several forms – for example, cash, deposits, livestock, jewellery, etc. They may also include regular inflows of cash including pensions and remittances. Finally, social assets refer to the living and non-living components comprising the biophysical environment that is used in production and that deliver ecosystem services to the benefit of current and future generations.

It must be noted that individual assets could be disrupted due to different environmental or other factors that may have an impact on the individuals' livelihood and among some of these environmental issues are disasters and of these disasters include flood which is one of the main causes that have an impact on the individual’s livelihood outcome.

Flood is an unexpected natural phenomenon that can disrupt any of the five assets in the DFID framework. When flooding occurs, the social asset gets threatened. In most cases, one has to worry about the state of the family in terms of safety and psychological state of mind. Concerning the natural and physical assets, these assets often bear the brunt of floods. In low-lying areas, liveability may be adversely affected since people may not be able to move easily since the roads or pathways may become unmotorable. Water resources, especially if they serve domestic purposes, may also become polluted making it difficult for the water needs of people to be adequately met. Similarly, the natural assets will also undergo massive changes during flooding since the structures that sustain the human ecosystem may be displaced.

As an external shock event, flooding certainly has a significant impact on the livelihood outcomes of individuals along the broad spectrum of the five assets. The severity of the flood will determine the degree and strength of the association between the flood and livelihood outcomes. Generally, however, livelihood outcomes across the five assets will have a negative association with floods – that is, when flooding occurs, the state of livelihood outcomes declines or is negatively affected. In most cases, the natural, physical, and financial assets are the worst hit in times of flooding. The evidence to support this claim is not far-fetched. One only needs to watch local news when there is flooding. The rather strong association between flood and livelihood outcomes of individuals across the five asset areas explains the creation, and continuing existence or relevance, of a specialized agency to alleviate the plight of flood victims: National Disaster Management Organization (NADMO).

2.2 Flood disasters

Floods occur when there is an overflow of water that submerges dried land not covered by vegetation (Thilagaraj, 2016). Floods are by far the most hazardous, disastrous, frequent, and

widespread disaster throughout the world (Kundzewicz et al., 2014), causing extensive damages to lives and property especially in developing countries where there are still bottlenecks in achieving sustainable resilience (Pachauri et al., 2018). According to Kithiia (2011), flood disasters have caused serious threats to city dwellers especially among coastal communities in Africa, where populations continue to rise with limited land space.

Urban areas due to the rapid growth of the population are usually seen as vulnerable areas to flood disasters (Bull-Kamanga et al. 2003). Action Aid (2006), stated that the destruction suffered as a result of flood disasters is usually a result of the activities and actions of human beings. In furtherance, Bull-Kamanga et al. (2003), contended that the vulnerability of the affected populations to floods is not only a natural phenomenon but the inactivity of the social, political, and economic system that governs it.

Bulkeley et al (2009) stated that the classification of floods as urban and rural is a challenge because definitions are not clear on the distinction between urban and rural areas and the similarities in the type of floods that occur over the two geographical spaces. Bulkeley et al (2009) noted that floods that occur within the urban areas should be distinguished from the floods that occur in rural areas due to the extent of damages incurred and the extent of the geographical area covered. The reason has been that urban floods occur in smaller geographical areas and such disasters record the higher intensity of damage, whereas rural floods occur over considerably large areas with little damage to property and life. Bulkeley et al (2009) could not provide full reasons behind the distinction between the urban and rural floods. Jha et al (2012), contribute to the discourse by stating that the level of infrastructure in rural areas exposed and damaged by floods is low compared to the floods which occur in urban areas. Reiterating, Siegel et al (2008) categorize urban flooding into four forms. The first is referred to as a localized flood or flash flood.

This form of flood occurs more frequently and, in most cases, covers very small and deplorable areas such as slums with poor drainage, limited drains, and blocked channels with all forms of waste. This flood closely relates to the floods that occur on the surface of the land. The second form of flood occurs in areas along small streams in urban areas, which rise quickly after heavy rains, flowing through small channels. Although authorities have designed a well-developed channel system, changes in the structure of urban areas, including the increasing number of settlements along streams coupled with increased rainfall intensity may result in an overflow of the channels or streams when its drainage capacity is exceeded. The third form of a flood is caused by dam spillage and major rivers, which provide water to urban communities, due to poor engineering works, dam water spillage and deposition of sediments in the dam may lead to an increase in the rise in the water volume of the dam or river causing an overflow due to excess water beyond the dam holding capacity. Further, coastal floods may also occur because of sea-level rise and overflow of inland water over immediate plains or low-lying lands (Takagi et al. 2016). According to the Institute of Local Government Studies (ILGS) and Intentional Infliction of Emotional Distress (IIED) (2012), floods that are more frequent in Accra include flash floods and river floods occurring when there is an overflow of dams and other sources of water bodies. Coastal floods also occur along with low-lying coastal communities in Accra (Appeaning, 2011).

2.3 Causes of Flood Disasters

Flooding is generally regarded as an environmental hazard. It is quite a natural process and is simply the reaction of a natural or man-made system to the presence of essence water at a particular period. There are several reasons for the causes of flooding in most urban areas. The reasons can either be grouped into human or naturally induced conditions. The human-induced factors, however, play a significant role in urban flooding compared to natural causes (Zhang et al. 2018).

2.3.1 Natural causes of flooding

Natural causes of flooding include rising global temperatures which in turn speeds the melting of glaciers and ice caps and cause early ice thaw on rivers and lakes (Hansen et al., 2016). This further increases the volume of water and causes the rivers or lakes to overflow their banks and hence, cause flooding (NRDC, 2015). Another natural cause of the flooding is associated with areas located near the coast. Coastal areas are more vulnerable to flood disasters because of their nearness to the sea. The earthquakes that occur beneath the ocean can lead to a rise in the seawater level which would further increase the volume of the sea and therefore, force the sea to overflow its banks, leading to flooding of coastal areas.

Moreover, the entire terrain of the Greater Accra region is a low-lying area. Flooding is more rampant in low-lying areas. The slow-flowing of the river bodies in these areas triggers floods whenever there is an increase in the water volume of the flowing body of water (Oppong, 2011). Rivers flow from steep heights through gentle slopes thereby, making it difficult for the water to infiltrate at steep slopes. This implies that the water is easily able to flow down to rivers and streams. According to Sharif et al. (2012), gentle slopes or flatlands allow easy infiltration of water into the soil and increase lag times. However, since the entire city of Accra appears to be a low-lying area, whenever, it rains the water flows easily through the steep lands and empties excess water at these low-lying areas which eventually gets flooded especially in areas that have a very poor drainage system to provide a channel for the free flow of the excess water collected.

2.3.2 Human causes of flooding

Oppong (2011) stated that human causes of flooding are the direct actions and inactions of humans. There is therefore a direct/indirect human influence of some sort. The human causes of flooding

include; the rapid increase in rural-urban migration, building in flood-prone zones, residing in low-lying terrains, lack of maintenance of the constructed drains, and apathy towards public facilities.

Concerning urbanization, the number of people migrating from rural to urban areas tends to be growing daily. A rise in urbanization increases the construction of buildings and structures for shelter and other activities. However, poor migrants who migrate into cities in search of jobs are usually not in the financial capacity to be able to acquire the available housing for residence. These poor migrants are, therefore, forced to migrate and settle in slums and areas cheaper to afford. Most of the areas occupied by these poor urban settlers are areas vulnerable to floods. Additionally, some of these urban migrants tend to build very weak housing structures exposing them to floods.

Building in flood-prone zones or wetlands is another factor that exposes residents to the risk of floods. According to Kusi-Appiah (2016), housing structures that are built in flood plains, wetlands, and even across natural watercourses are exposed to the risk of flood disasters. Reiterating, NADMO (2014) added that the unauthorized buildings sited right on watercourses further distort the drainage network system and obstruct the free flow of water which eventually leads to floods.

In furtherance, the lack of maintenance culture of constructed drains in the various municipal assemblies increases the risk of floods. Most of the existing constructed drains lack the maintenance culture and barely serve their purpose of construction (Kusi-Appiah, 2016). According to Kusi-Appiah (2016), the periodic maintenance and desilting of pre-existing drains can be greatly improved by the regular inspection and cleaning of channels, pipes, and channels. The regular maintenance culture of drains helps in reducing the risk of flood disasters among populations.

Additionally, the apathy level towards public facilities among some Ghanaians is but another factor that hinders the maintenance culture of public facilities. Many Ghanaian citizens do not consider themselves accountable for the maintenance of these facilities. Therefore, these public goods are used carelessly without regard for maintenance. Again, stealing and destruction of movable public goods are common. Public goods that are left unprotected are sometimes stolen and citizens do not feel obliged for the safety of public goods. There is, therefore, a need for a change of apathy towards public facilities. Considering that, it is difficult to change the behaviour of human beings towards maintenance culture, it is, therefore, important that the government together with other state institutions to increase public awareness on the relevance of protecting state property. An important tool towards achieving this aim is the education of communities regarding the necessity of developing a good maintenance culture. When more communities are enlightened and educated on the necessity to enhance maintenance culture, it would help provide knowledge on the need to desilt drains and maintain a maintenance culture system to reduce their level of risk to disasters such as floods.

Last but not least, the impact of waste management practices and the incidence of flooding most especially in urban areas are interconnected. About 2.58 million tons of raw plastics are imported into Ghana annually, of which 73 percent effectively end up as waste, while only 19 percent is re-used (Bonsu. 2020). Sadly, less than 0.1 percent of the waste is recycled, meaning all the plastic waste generated ends up in the environment. The associated challenges in poor plastic waste management are increased risk of flooding which may result in disasters, an outbreak of diseases such as cholera, and other risk continuum related acts which is worrisome and a great threat to Ghana’s human resource and retards development at large.

2.4 Flood experience in Ghana

Every year, floods affect more than 200 million people with a higher record than the records shown by other climate-related disasters (UNISDR, 2011). Floods have become the most frequently occurring and devastating disaster in Africa, causing loss of lives, property damage, and promoting the spread of diseases such as malaria, dengue fever, and cholera (Baffoe-Bonnie et al., 2006). Owusu and Agbozo (2019), highlighted that floods in Africa killed almost 20,000 people and affected nearly 40 million more, and caused damage estimated at US$4 billion between 1900 and 2006. Several floods occurred in Ethiopia in May 1968, August 1994, and May 2005, causing damage estimated at US$ 0.9, 1.5, and 3.5 million, respectively (Guha-Sapir et al.2016). The period 1997-2008 alone witnessed about 166 floods and many other natural urban disasters in 28 African cities (EM-Dat, 2008; cited in Songsore et al, 2011). Over the years, flooding has been an issue of concern in Ghana as it has caused severe damages to lives and properties. In the late 1960s, almost every part of the country experienced heavy floods owing to major rivers including the Pra, Offin, and Ankobra overflowing their banks causing floods in adjoining communities and cities (Atuguba and Amuzu, 2006; Sam, 2009). Transportation (rail and vehicular) was seriously impeded and many commercial activities were halted. Serious floods and devastation have been experienced since the 1990s to date. For example, in 1999, rainfall-induced storms accounted for coastal floods that resulted in many deaths across coastal parts of Ghana, with Greater Accra very much affected. In June 2001, heavy rains caused extensive flooding in Ghana and Greater Accra was no exception, the flood left about 11 people dead and over 100,000 homeless. In 2005, Ghana was one of the worst-hit countries in Western Africa that experienced severe flooding. The Daily Graphic (2005) reported that about 20 lives were lost across the Upper East, Upper West, and Northern regions during the floods of June 23rd, 2005. In 2007, floods affected Northern Ghana;

killing about 61 people with 25,923 houses affected (damaged, collapsed, or washed away). Besides, 70 feeder roads were destroyed and over 97,000 hectares of farmlands were destroyed. According to a report by the Ministry of Environment, Science, Technology, and Innovation (MESTI) (2015), the government and other international agencies spent about US$25 million in relief and recovery activities. In 2009, the damage cost was approximately US$5,800,000, and 51,965 people were affected in seven regions (Western, Central, Brong-Ahafo, Volta, Ashanti, Eastern, and Greater Accra). The National Disaster Management Organization (NADMO), estimated that approximately 350,000 people were severely affected during the 2005 floods and that several hundred hectares of crops and farmlands were destroyed (ActionAid, 2006). The study of ActionAid (2006) projected that many more deaths attributable to flash floods could occur across Ghana, in addition to those resulting from the more usual cause of river flooding. Together with ActionAid (2006), Atuguba and Amuzu (2006), indicated that over 25% of the population of Accra lives on fluvial flood plains or areas identified to be at risk from fluvial flooding. The Greater Accra region has about 50% of its population living on the floodplain of the Densu and the tributaries of other rivers (Atuguba and Amuzu, 2006). NADMO (2014) reported that between 1995 and 2009, frequent floods were recorded in Accra that resulted in human casualties, displacement of people, infrastructure damage, and also led to a halt in economic activities (AMA and UN-HABITAT, 2009). Alderman et al. (2012) stipulated that, the effects of floods cut across all the demographic and socioeconomic groups in the Metropolis varying from delay in economic activities, psychosocial stress, and emotional disturbances among others regardless of where one lives. Alderman et al. (2012) further asserted that apart from property damage and loss of lives, floods have contributed towards disease outbreaks and the pollution of water bodies available for

urban consumption. He noted also that many areas in the Accra metropolis have had their drinking waters contaminated and face the risk of a cholera outbreak.

The menace of flooding can be positioned in the bigger context of disaster risks in Ghana. The country has suffered 13 major incidences of floods, with the majority occurring in major urban areas in the country. The major flood event occurred in 1968 with about 25, 000 victims with recorded damages and properties. The flood event that occurred in 1991 was the most catastrophic, as over 2,000,000 lives were affected.

In contemporary times, the 3rd June 2015 flood in Accra was a memorable one. The extent of this flood was high, it lasted for almost six hours, causing the death of 150 people with 86 injured people (MESTI, 2015). The total number of people estimated to have been affected by the June 3rd flooding is about 52,622. The extent of the flood was obvious in the number of areas that were affected. Five main administrative areas within the Greater Accra Metropolitan Area (GAMA) were affected by the June 3rd disaster. This includes areas in Accra Metropolitan Assembly (AMA), Ledzokuku-Krowor Municipal Assembly (LEKMA), La Dade-Kotopon Municipal Assembly (LADMA), TMA, Kpone, and Ga South/Central (UNCT, 2015). Cost estimates of the flood disaster amounted to GHS 242 million (USD 55 million).

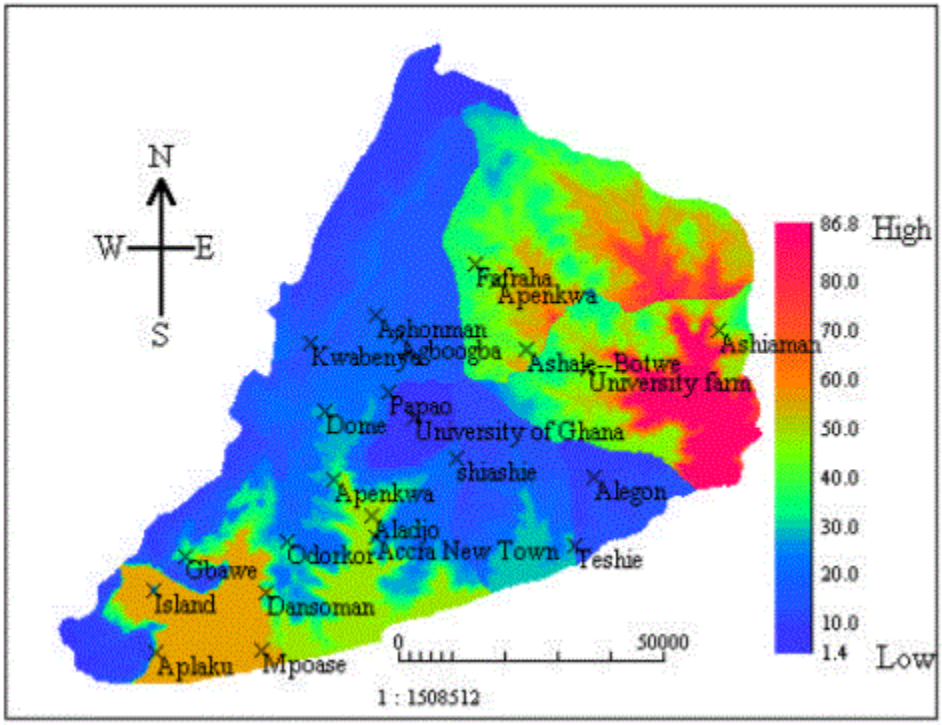
2.5 Flood risk zones in the Greater Accra Region

Risk refers to an element of danger and the probability of suffering loss or harm. Risk studies here gained attention in many discourses and many fields of study including population and environment studies. The study of risk can be categorized in different perspectives namely; identification and estimation of risk, monitoring and risk management, then lastly, risk evaluation, and assessment. According to Renn (1992), the concept of risk can be classified into seven units

namely: the actuarial risk, the epidemiological or toxicology risk, the engineering risk which includes; probabilistic risk assessment, the economic risk assessment which includes risk-benefit comparisons, the psychological risk which includes psychometric analysis, social theories of risk such as sociological and anthropological studies and lastly Cultural theories of risk such as the use of grid groups analysis.

In this study, the risk is used to imply the probability of human life and properties within the study area to be affected by floods and their impacts on their livelihood. Below is a runoff concentration map that shows the areas that are liable to flooding.

Figure 1 Run-off Concentration Map of the Areas Liable to Flooding



Source: (Nyarko, 2002)

Regarding the map above, areas that present a different pixel value ranges from low to high. Areas that fall within an elevation between 350 meters and 1550 meters had low pixel values between 0 and 20 and the areas with an elevation below 350 meters show a high pixel range between 20 and

87. Reiterating based on the ground depicts that higher elevation has low pixel values which show that there are areas with low flood risk possibilities. Meanwhile, areas that have low elevations indicate a higher pixel value which shows that these areas experience yearly flooding at every given rainfall period. Therefore, areas such as Ashiaman, Aladjo, and Sakumonu fall within the high pixel values ranges which indicates that these areas experience destructive floods with high rainfall intensities. These pixels when put together can be grouped into values based on their level of severity. the grouping is classified as very high, high, moderate, very low, and low-risk zones. This, therefore, helps to differentiate between the areas that experience floods and their level of intensity.

2.6 Flood experience and livelihood

The International Labour Organization (2006) defined livelihood assets as the capabilities, assets (including both material and social resources), and activities required for a means of living. Carney (1998) argued that livelihood entails five vital assets namely; human, physical, financial, and social capital. These assets form the livelihood concept.

According to Jha et al. (2012), flooding poses a developmental challenge to societies, it causes economic damages and loss of lives. Floods are one of the environmental disasters that follow disease and accidents. Statistics have shown that 20,000 lives are lost yearly and about 20 million lives are lost worldwide (Smith, 2004).

At the global level, the impact of flooding on livelihoods is evident in many areas. Flooding in Cumbria, a county in the United Kingdom in 2005 and 2009 caused a devastating effect on livelihoods. The flooding in 2005 caused £450 million worth of economic loss (Chatterton et al. 2010). Also, a flood in England in 2007 caused the loss of life and major impacts on the health and

well-being of people living and working in the areas affected, with £3.2 billion economic losses (EPA, 2011).

According to Tall et al. (2012), the flood that occurred in July 2007 in West Africa was the most awful kind of flood in thirty years. This is because, more than 210 deaths were recorded, and more than 785,000 people were affected.

In Ghana, flooding is one of the environmental disasters that cause loss of lives and livelihoods. In August 2007, flooding affected about 350,000 people with 49 casualties in the Northern parts of the country along with estimated damage of over US$ 130 million (EPA, 2012). Similarly, a study conducted by Braimah et al, 2014 showed that floods affect the economic, social, and physical lives of people. In their study, it was revealed that families spent between GH¢ 50.00 and GH¢300.00 to treat family members who were victims of flood disasters.

Furthermore, in Ghana, an estimated number of 3.8 million livelihoods have been disrupted by flood disasters and an estimated 180 million dollars' worth of items has been lost (Ansah et al. 2020).

The livelihood construction of the poor in the urban area is based on the opportunities and limitations confronted within the community in which they live (Antwi et al. 2014). These factors are militated by the power relations and the socio-cultural drivers that differentiate the level of access to diverse productive assets within the community (Owusu, 2017). There is a high cultural diversity in the urban areas, making them socially disjointed as compared to some rural areas. This has, therefore, contributed to the inability of the poor in the urban area to make a good living through access to social assets. The increase in the demand for labour in the cities provides an opportunity for the poor but at the same time also increases their dependence on cash incomes (World Bank Group, 2016).

This impact, coupled with the high cost of living in these urban areas places huge burdens on the poor particularly those engaged in the informal sector of the economy. This is because the poor would require a higher income to enable them to make a living in the urban areas as compared to the rural areas. For example, a study conducted in Bangladesh among poor urban residents indicated that only 45% of the sample could have a surplus after paying the cost of their necessities such as rents and bills at the end of the month (World Bank Group, 2016). This occurring situation limits especially the poor urban residents to be able to save. The situation is worsened when these poor urban residents are confronted with annual or seasonal cases of flooding.

The high cost of living in the urban areas coupled with high housing rents and taxes makes life unbearable for the poor thereby, forcing them to occupy marginal lands that lack access to proper sanitation and are usually exposed to the risk of floods (Amoako, 2015). Moreover, the livelihood of most of these dwellers is frequently faced with severe disruptions of floods (Braun & Aßheuer, 2011). This intends, jeopardizes their basic livelihood assets, resulting in a cycle of flood risk on their livelihood (Afriyie et al., 2017).

The poor housing structures inhabited by some of these residents, in turn, places abundant constraints on their human capital through compromised health situations. Hence, diseases such as malaria and cholera ensuing from closeness to waste dumping sites, lack of quality air, and the lack of access to clean water (Amoako, 2015). It should though be noted that a number of these residents tend to improve their economic conditions at their destinations amidst the conditions in the urban areas (Awumbila, Owusu, and Teye, 2014).

2.7 The role of Government in flood management

In the advent of flooding and its associated effects, the role of government becomes prudent in reducing flood experience and impacts. Many countries especially the developed countries have put in place measures to mitigate the adverse impacts on the populace. Countries such as the Netherlands, Germany, and the United Kingdom are leaders in adopting flood risk management as directed by the European Union's 2007 Flood Directive (Hartmann and Spit, 2016). Flood risk management is a strategic framework for assessing, evaluating, and mitigating the impact of the flood (Sayers et al. 2013).

Institutional and stakeholder role has become necessary in tackling flood. Ahadzie and Proverbs (2011) acknowledged the effort of the National Disaster Management Organization (NADMO) in flood situations, constituting a rapid response team to deal with the situation. However, the weaknesses in its operations as it can only offer advice to people in the event of disasters and have no power of enforcing evacuation. A study conducted by (Ahadzie & Proverbs, 2011) showed that the lack of a flood risk management plan to predict, plan, and warn potential flood victims has been one of the predicaments of NADMO.

The government's role in flood experience management has not been effective and is short-term oriented. During floods, NADMO only provides relief items to flood victims with support from non-profit organizations and international humanitarian agencies. The approach of government to flood experience according to many Ghanaians is kneejerk and not proactive (Owusu, 2017).

The government in its efforts to improve sanitation and reduce the occurrence of flood has initiated in 2014 national sanitation day, where every first Saturday of every month choked gutters are cleared, and clean-up exercises are undertaken at the community level (IFRC, 2018). The local government workers union of Ghana (LGWU) has described the sanitation day program as a

national duty call and admonishes all citizens to participate. This initiative has been described as a knee-jerk response to promoting a healthy environment and, as a result, addressing the impact of any future flood in the city (Tengan & Aigbayboa, 2016). Governments have made significant commitments to build hundreds of kilometres of storm drains along key river basins, as well as water retention reservoirs in the capital (Ghana – Floods Situation Report, 2015). The capacity of the created or existing drains is restricted, according to Adorsu-Djentuh (2018), due to their size and the fact that they are occasionally silted or choked with garbage. As a result, determining the volume of runoff water during floods is necessary to guarantee the proper design and construction of new storm drains.

In order to combat floods, institutions and stakeholders must play a role. Though the efforts of NADMO in flood events are appreciated, the institution needs much more legislative backings and financial support to make them proactive rather than reactive approach. Until recently NADMO could not evacuate people when needed, this has accounted for the adverse impacts of floods the country has witnessed in previous years (Ahadzie & Proverbs, 2011). In flood conditions, Ahadzie and Proverbs (2011) recognized the efforts of the National Disaster Management Organization (NADMO), which formed a quick reaction team to cope with the issue. However, its operational flaws, such as the fact that they can only provide counsel to individuals in the case of a crisis and have no authority to enforce evacuation, must not be forgotten (Ahadzie, D. K. and Proverbs, D. G., 2011). The city's efforts to control the issue are being hampered by obstinate people and ineffective law enforcement. In Ghana, there is very little education to help people understand flooding and how to forecast it. It is critical to understand that when limited or no information about the likelihood of a heavy storm leading to severe flooding is recorded, it is inadequately disseminated and taken for granted by the majority of Ghanaians. According to findings from a

2011 research by Ahadzie, D. K., and Proverbs, D. G., the country lacks a well-developed flood risk management plan to forecast and warn flood victims.

2.8 Conceptual framework of the study

This section provides a review of the conceptual framework of the study. The study is guided by the Sustainable Livelihood Framework model from which the conceptual framework for the study is derived.

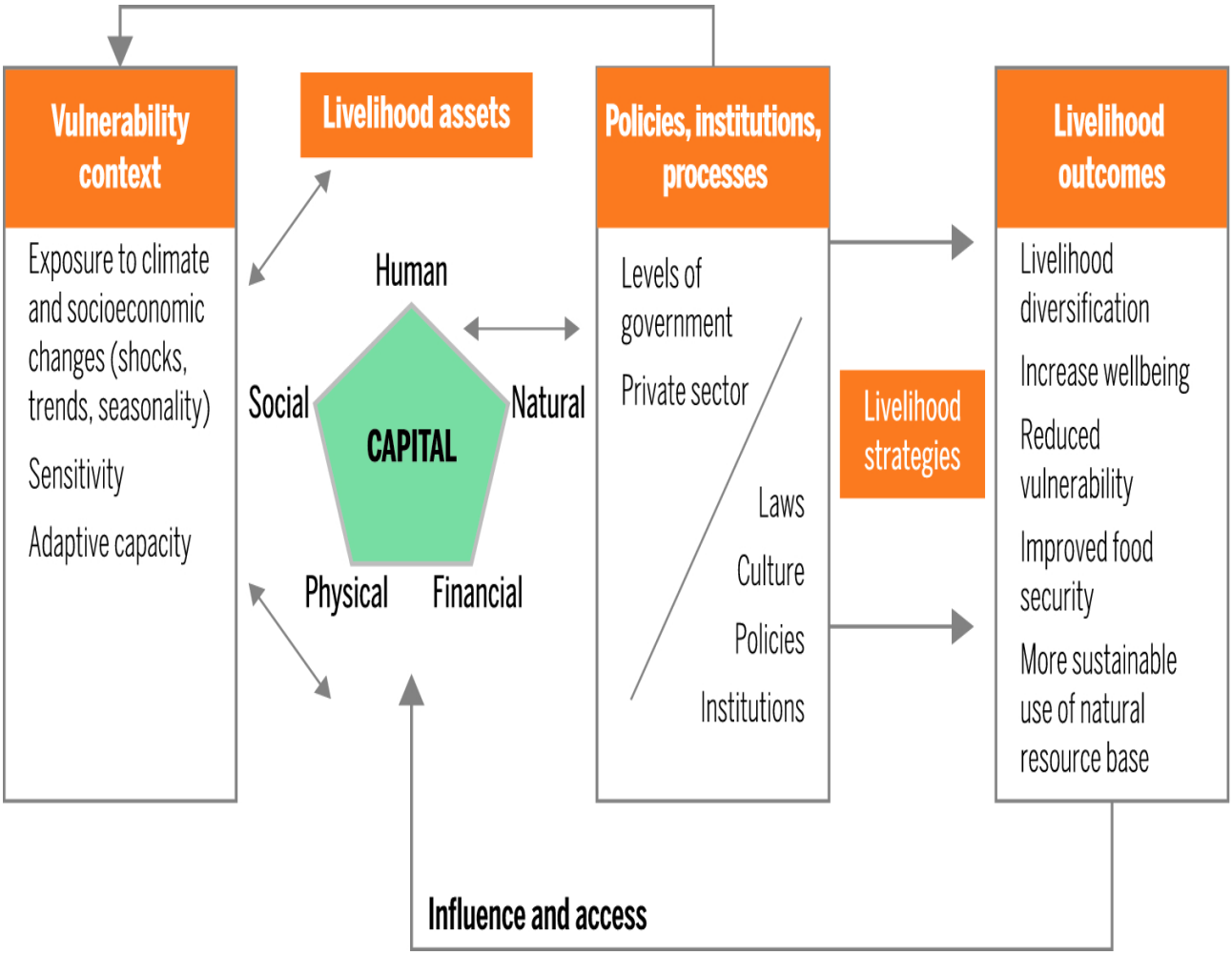
2.8.1 Sustainable Livelihood Framework (SLF)

The sustainable livelihood framework is a community-based assessment of the livelihoods of individuals based on their risk to danger and their capabilities. This framework is used to evaluate the strength of communities based on their assets and how they can regenerate these assets into desirable outcomes. A livelihood system includes the assets and capabilities necessary for human survival (Chambers and Conway, 1992, p. 7). The sustainable livelihood approach was initially adopted to assess the livelihood systems of poor communities; however, this sustainable livelihood approach can also provide insights in assessing the capacity levels of communities' disasters such as floods (Antwi-Agyei et al., 2013). The main components of the Sustainable Livelihood Framework include; livelihood assets, transformation processes, vulnerability context, and livelihood outcomes (DFID, 1999; Serrat, 2017). The livelihood assets of people are affected by some factors. These factors include the environment, seasonal or unforeseen events, and an increase in the rate of population growth (Rakodi, 2014). The five types of assets in the Sustainable livelihood framework include; Physical capital, Human capital, Financial capital, Social capital, and Natural capital.

Whereas, the transformation process in the sustainable livelihood framework refers to the interventions of the government and private firms. Which eventually influences people's access to resources and assets (Serrat, 2017). An understanding of the transformation process or structure is a very important strategy for an effective adaptation process in urban areas.

Moreover, the vulnerability concept can be expressed as exposure to the risk of a disaster and also entails the coping mechanism strategies (Resilience capacity) in mitigating the impact of flood disasters.

Figure 2 Sustainable Livelihood Approach Framework



Source: DFID (1999) p.1

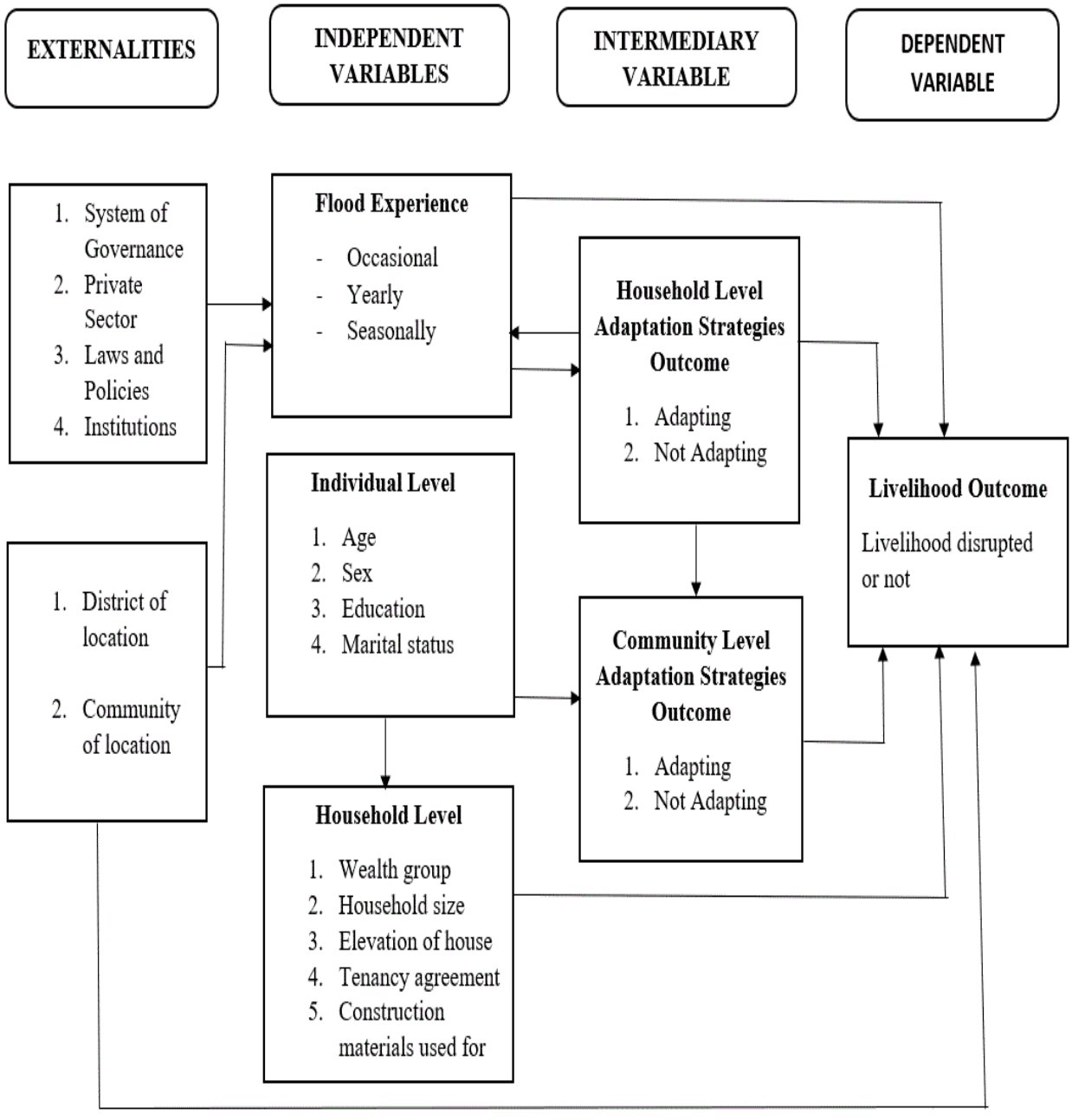
2.8.2 Conceptual framework

The conceptual framework on the impacts of flood experience on the livelihoods of selected communities within the Greater Accra Metropolitan Area (GAMA) was adapted from the Sustainable Livelihood Framework DFID (1999) p.1. This framework examines the impact of flood experience on livelihood outcomes. The independent variable is the severity of flood experience which indicates the levels of flood experiences among households. This can be influenced by external factors labelled in the structure as externalities which include the interventions that the government takes to help reduce the prevalence and severity of flood experiences and their impact on livelihood. Example of these interventions includes government policies such as building permits which serves as a guide to preventing citizens from building on wetlands. The intermediary variables also take into account the individual interventions taken by community members to reduce their level of flood experiences as well as its impacts on household livelihood. Some of these measures include; desilting of gutters, construction of drains, and prohibition of dumping waste in unauthorized areas. All of the above consequently impact greatly on the livelihoods of individuals either positively or negatively when these checks are properly or not properly put in place.

The study also controls for the socio-economic and demographic variables that play a role in the impact of flood experience on household livelihood disruption. These socioeconomic and demographic factors include; the age of the household head, sex of household head, educational attainment of household head, wealth group of households, the elevation of the house, tenancy agreement of households, district and community of residence, wall construction materials used, household adaptation strategies used and community-level adaptation strategies adopted. These

socioeconomic and demographic factors can either make households more or less vulnerable to the impact of flood experience on their livelihood outcome.

Figure 3 Conceptual Framework on the Relationship Between Flood Experience and Household Livelihood Disruption Outcome



Source: Adapted from DFID (1999) P.1

2.8.3 Limitations of the Sustainable Livelihood Framework

The sustainable livelihood framework has been criticized for not taking into account the population factors such as the role of culture in access to assets (Morse & McNamara, 2013). Though the framework was more concerned with the livelihoods of persons especially the poor in society, there was very little concern about the role of culture and gender in access to assets (Tao et al. 2010). Additionally, the framework did not provide an accurate measurement of the assets that define the concept of livelihood. It did not further explain whether all the assets are to be measured or selected assets can be chosen and measured independently (Morse & McNamara, 2013). However, this framework is relevant to the study in providing the assets needed in the measurement of livelihood and also provides the factors that influence the livelihood assets. Moreover, this study also addresses the concerns on gender since the study uses a segmented data set into age groups and gender. This allows an assessment of the gender analysis of the populace.

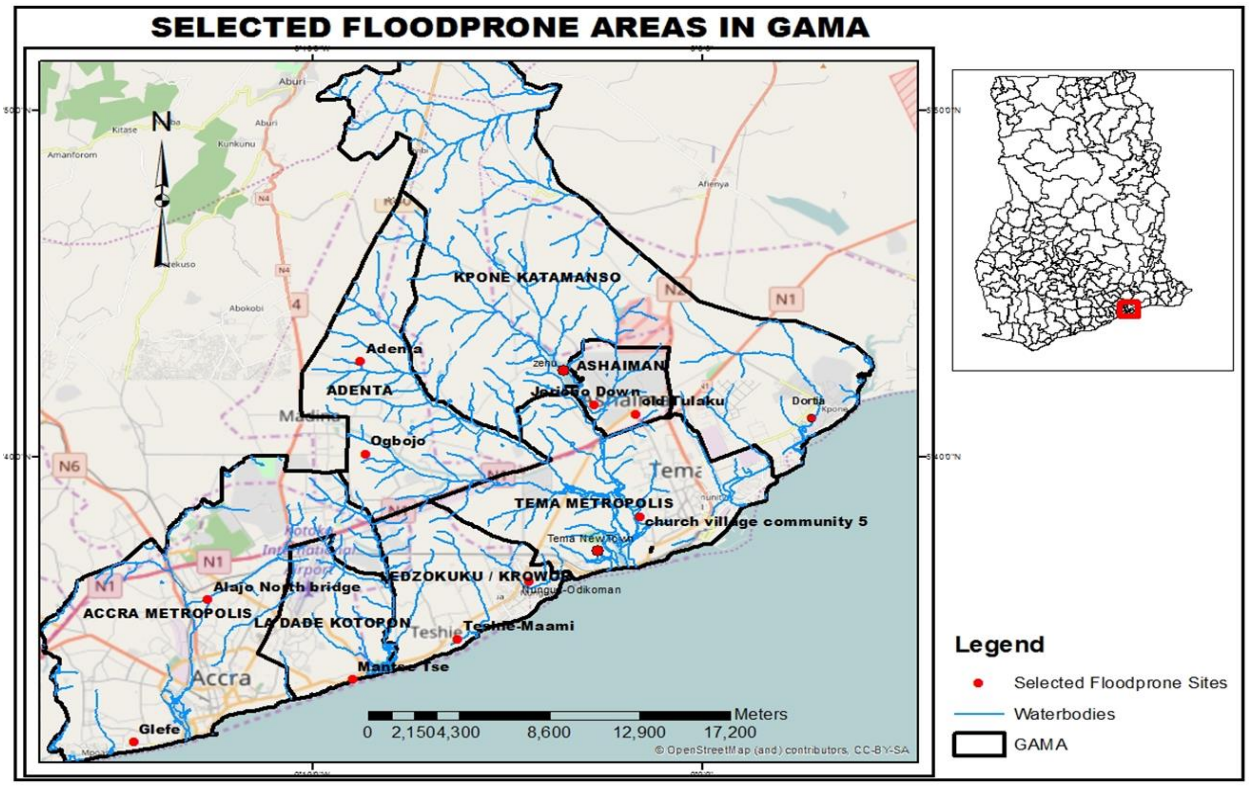
CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter describes the study area, sources of data, methodological intersections, and data/information flow, the variables of interest, and the analytical methods based on the selection of variables for the study.

3.2 Study Area Map and Description

Figure 4 shows the Study Area Map



Source: (Cities and Climate Change Dataset, 2017)

The Greater Accra Metropolitan Area (GAMA) falls within the Greater Accra Region. The area lies within the dry equatorial climatic zone and experiences a double rainfall maxim with a

prolonged dry season. The rainy season within the area records a monthly mean temperature of 27^0c. The rainy season falls between May to August and then from October to November with an annual rainfall of 780 mm to 1200 mm. The vegetation types within this geographical area are the mangrove forest and the coastal scrubs. Whilst the mangrove forest is found in the waterlogged areas, the coastal scrub and grassland are located in areas with trees such as the Baobab and Nim.

3.3 Demographic characteristics of the study area

According to the 2010 population and housing census, the Metropolis' total population was estimated at 1,665,086 people, with females accounting for 51.9 percent and males accounting for 48.1 percent. The population peaked in the age group 20-24, accounting for 12.4 percent of the population, followed by the age group 25-29, accounting for another 12.4 percent (11.5 percent). Almost all age categories in the population recorded a higher proportion of females. In terms of sex ratio, there were around 93 males for every 100 females in the Metropolis. The Metropolis' sex ratio is lower than the national average of 95.2 (GSS, 2012). This might be due to male mortality in the Metropolis being greater than female mortality or male out-migration. The total fertility rate of Accra Metropolis is 2.2 and below the regional average of 2.6 while the crude death rate is 4.4 per 1,000, somewhat higher than the regional average of 4.3 per 1,000 (GSS, 2012).

3.4 Environment and health in the Greater Accra Metropolitan Area (GAMA)

Due to the increasing rate of the Greater Accra population at 2.62 percent (GSS, 2012) and services are not supplied, most citizens live in a dismal environment resulting in poor health care. In poor neighbourhoods, poor environmental and health circumstances lead to high infectious illnesses like cholera, diarrhoea, typhoid fever, and respiratory tract infections.

3.5 Methodological intersections and data/information flow

The 2017 Cities and Climate Change survey was conducted with knowledge base information from several baseline and vulnerability studies assessments between the period 2008 to 2014. Lessons from the previous projects provided the pathway to conducting the project. The project used a combined methodological process and approach for assessing flood experience in the Greater Accra Metropolitan Area (GAMA) and how it is linked to developing a Climate-Smart Integrated Flood Management Framework (CSIFM).

The assessment of flood risk in the Greater Accra Metropolitan Area (GAMA) began with the acknowledgment of the potential of floods as a hazard and the understanding that floods pose a physical vulnerability to the environment. The use of satellites and the evidence base ground truth facts were used to identify and map flood-prone areas with the coastline as the reference source. The identification of the key informants of the communities aided in the canvassing of the area. The areas with watermarks were identified as exposed surfaces to the risk of floods. Through the District Town Hall meetings, various stakeholders and actors from different communities and organizations met for deliberation. It came to an understanding that the complexity and heterogeneity associated with flooding that is confronted with each district included; the identification of hotspot zones, identification of community facilitators, identification of actors and policymakers, and the reappraisal of sampling methods and field designs.

3.6 Sources of data

The study used secondary data derived from the 2017 Cities and Climate Change survey conducted by the Regional Institute for Population Studies (RIPS), University of Ghana. The Cities and Climate Change study was conducted in 14 selected communities in the seven districts of the

Greater Accra Metropolitan Area (GAMA). These seven districts include; Accra Metropolitan Area (AMA), La Dade-kotopon Municipal (LADMA), Le Dzokuku-krowor Municipal (LEKMA), Adentan Municipal, Ashaiman Municipal, Tema Metropolitan, and Kpon Katamanso District (KKD). The communities were selected because of their prevalence and vulnerability to the occurrences of flood disasters.

Two communities each were selected within these districts making 14 selected communities. These were chosen because of their prevalence and previous flood experiences. The survey collected information on socio-demographic and economic characteristics, awareness of climate change or variability, key adaptation strategies, climate timelines, and mitigation strategies among others adopted by households reducing their vulnerability to flooding hazards.

3.7 Sampling size and design

The 2017 Cities and Climate change survey sampled selected communities that were exposed to the occurrence of flood disasters. The study was conducted in 2017 within Seven (7) Districts in the Greater Accra Metropolitan Area (GAMA). This study used the quantitative data gathered from 14 selected communities with three enumeration areas each making a total of 42 selected enumeration areas covered in the study area. In all, the study sampled a total of 1290 households in the Greater Accra Metropolitan Area (GAMA). From the total sample, 1252 households were identified, and 1230 completed the interviews with a 95.3% response rate. Of these, a little over 50 percent (823) households head experienced floods either seasonally, yearly, or have experienced floods occasionally within five (5) years preceding the time of the survey. This study instituted the quantitative data method of analysis which allows the researcher to study the opinions, attitudes, and behaviours of the population to be able to generalize the census population.

Quantitative research also gives the researcher the chance to study and understand the relationship between the dependent and independent variables and how much of the difference in the outcome variable is accounted for by the independent variables.

3.8 Measurement and definition of variables

This section of the methodology provides information on the definition and measurement of the variables used in the study.

3.8.1 Dependent variable

Livelihood outcome is the main dependent variable for the study. The sustainable livelihood framework provides the framework for the assessment of the livelihood assets. However, livelihood outcome in the study is measured using physical and financial assets. This is because the dataset used included mainly assets on physical and financial livelihood. Livelihood asset in the study is computed using a composite index analysis of physical, and financial livelihood assets. The physical assets included 46 variables measuring whether or not households' assets were disrupted by floods. This was measured as 0 for no asset destroyed and 1 for assets destroyed. These assets included the properties owned by the households. These properties were then computed as a single variable as ''was (name) physical properties destroyed by floods''? The responses were then categorized as 0 for No Physical Property damaged and 1 for Physical property disrupted. Financial livelihood asset was also measured as whether or not their main economic activity was destroyed. The responses to the main economic activity disruption were categorized as 0 for No, and 1 for Yes. The livelihood outcome variable was then computed by adding the two variables which provided a scale range of 0 to 2. Those respondents who either had

one or both of their livelihood affected was then coded as 1 whilst those who recorded a zero (0) score indicated that they had neither of the two livelihoods affected.

3.8.2 Independent variable

The independent variable of interest for the study is Flood experience. Flood experience is measured by three (3) questions in the dataset thus; Is flooding a frequent occurrence in your neighbourhood (fl01)? how frequent is the occurrence of floods in this neighbourhood in the last 5 years (fl02)? And lastly, In the last 5 years has your neighbourhood experienced any floods (fl04)? These questions assisted the measurement of flood experience in the selected communities within the Greater Accra Metropolitan Area (GAMA).

However, for this study, these indices were recorded to provide a better understanding of the measurement of flood experience. The study then computed a variable of flood experience measure from the three (3) questions that were asked from the 2017 Cities and Climate change dataset. Therefore, the independent variable (flood experience) is categorized as 1= households that experience floods occasionally, 2 = households that experience floods yearly, and 3 = households that experience floods seasonally.

3.8.3 Explanatory variables

Studies conducted by Shah et al. (2017), Kellens et al. (2011) & Winsemius et al. (2015) have associated flood experience to be influenced by variables such as age, sex of household head, educational level, district of residence, etc. Therefore, these variables are controlled for in this study to avoid them becoming confounders and affecting the analysis of the study. The age of the household head was given as age in completed years. However, for the study, Age was then

recoded into three (3) categories as 1= household heads below age 30, 2=household heads between the age group 30 years to 55 years old, and 3=households head who were 56 years or beyond as at the time of the 2017 Cities and Climate Change survey. The sex of the household head was categorized as a categorical variable grouped as male and female. The marital status of the respondents was a categorical variable and was, however, recoded to suit the study as 1=Never married, 2= Married or living together and 3= Formerly in a union. The educational level of the respondents in the 2017 Cities and Climate Change dataset was categorized as None, Primary, JHS/JSS, Middle, SHS/SSS, Vocational/Technical, Post-Secondary, Bachelor degree, and Postgraduate. However, for this study, the educational attainment of these respondents was recoded as 1= Below Junior High School level of education, 2=Junior High School / Middle school level of education, and 3=Senior High School or beyond the level of educational attainment. Whereas the employment status of respondents was also a categorical variable in the dataset but was recoded as 1=domestic / casual work, 2= self-employed without employees, and 3= paid worker/job owners. The household size was measured as a continuous variable in the dataset. However, for this study, the variable was categorized as 1=households with 1-2 members, 2=households with 3-5 members, and 3=households with 4 or more members. The wealth group of the households was then computed as a measure of assessing the household wealth grouping. This was done using the principal component analysis of questions that were asked in the dataset. These questions were targeted at measuring the wealth of households based on their assets owned. These assets were then computed and used to group the respondents into three (3) wealth groups thus; 1=poor wealth group, 2=middle wealth group, 3=rich wealth group. With regards to the elevation of houses of residences, the study measured it based on the number of blocks that were used in raising the building relative to the community level. This was coded as 1= Less than 1

block, 2= 1 block (6 inches) and 3= two (2) or more blocks used. Again, the tenancy of the respondents also included whether or not respondents were residing in a rented or owned apartment. This was coded as 1=owning, 2=renting, and 3=others (Rent-free, perching, or squatting).

The district of residence is a categorical variable categorized as Accra Metropolitan Area (AMA), Ashaiman Municipal, Adenta Municipal, Tema Metropolitan, La Dade-kotopon Municipal Assembly (LADMA), Le Dzokuku-krowor Municipal Assembly (LEDMA), and Kpon Katamanso District (KKD). The communities of residents among the seven (7) districts were included; Alajo, Glefe, Gbegbeyisie, La Agyeman Motomoo, La, South Teshie, Nungua, Nungua (Coco Beach Area), Ogbojo, Adenta East/New Legon, Old Tulaku, Lebanon/Jericho, Ashaiman, Tema New Town, Community five, Kpone-Dortia, and Zenu. The construction materials used in wall construction also included materials such as cement/concrete materials and non-cement or none concrete materials used. Lastly, the study also measured the level of adaptation at both the household and community level adaptation outcomes.

Table 1 Measurement of the Explanatory Variables

Variable	Description (Measurement of Variables)
Age of household head	Captured as a continuous variable. However, for this study, the age variable was then recoded into three groups. 1= Less than age 30, 2= ages 30 – 55, and 3= 56 years and beyond.
Sex of household head	Measured as a categorical variable and coded 1=Male; 2= Female.
Marital status of the household head	Measured as a dichotomous variable. This was recorded as 1=Never married 2=Married or Living together and 3=Divorced or Separated.
Educational level	Educational level of the respondents was categorized as 1=None, 2=Primary, 3= JSS/JHS, 4=Middle, 5=SSS/SHS, 6=Voc.Tech, 7=Post Sec, 8=Bachelor Degree, 9=Post Graduate. But for this study, this was recoded as 1=Below JHS, 2= JHS/Middle and 3= included SHS/SSS and beyond.

Employment Status	This was an eight (8) categorical variable. It was recoded into 1= Domestic/Casual workers, 2=Self-employed without employees, and 3=Paid or Job owners	
Household size	This was a continuous variable in the dataset. For this study, this was categorized as 1= less than 3 members, 2= 3 - 5 members, and 3= 6 or more members.	
Household wealth group	The household wealth group was computed using the principal component analysis (PCA) of several variables that measured the possessions of households. The computed variable (Wealth group) is then coded as 1= Poor, 2= Middle, 3= Rich.	
Elevation of entrance	The elevation of the dwelling was measured based on the level of entrance of their houses relative to the level of the community. For this study, this was coded as 1= less than 1 block (6 inches), 2=1 block (6 inches), and 3= 2 blocks or more (12 inches).	
Tenancy agreement	Variable measured based on whether households were residing in a rented or owned apartment. 1= owned, 2= rented apartment, 3= others (households residing in a rent-free house, perching or squatting).	
Construction materials used for building the wall	Main materials that were used in the construction of the dwelling. Recoded as 1=Cement/Concrete, and 2= Non-cement/ None concrete materials used in the construction of the dwelling.	
Household-level of adaptation	In the data, this included whether or not households were using some adaptation strategies to minimize flood disasters. Adaptation at the household level was computed based on 5 variables. This was coded as 0=No adaptation and 1=adapting	
Community-level of adaptation	Adaptation outcome at the community level was measured as whether or not there was an adaptation used at the community level. Adaptation at the community level was computed based on 4 variables. It was coded as 0=No adaptation and 1= adapting.	
District/Community of location	1=AMA 2=LADMA 3=LEKMA 4=Adentan 5=Ashaiman 6=TMA 7=KKD	Glefe and North Alajo La Agyeman Motomoo and La South Teshie and Nungua Ogbojo and Adentan East Old Tulaku and Lebanon Community Five and Tema New Town Zenu and Kpone

Source: (Author's Construct, August 2020)

3.9 Methods of analysis

The study employed three levels of analysis to assess the impact of flood experience on household livelihood in 14 selected communities within the Greater Accra Metropolitan Area (GAMA). The Statistical Package for Social Science (SPSS) version 23 application was used for the analysis of data. The study used univariate, bivariate, and multivariate methods of analysis.

3.9.1 Univariate analysis

The univariate level of analysis used frequencies and charts to show the characteristics of households. This section presented an analysis of each of the variables in the study. The characteristics of the households presented in this section included households that have experienced floods within the last five years preceding the time of the survey.

3.9.2 Bivariate analysis

At the Bivariate level of analysis, the study used a cross-tabulation and chi-square test of significance to examine the association between each of the independent variables on the dependent variable. The chi-square test was performed to test the association between each of the independent variables on the dependent variable.

3.9.3 Multivariate analysis

At the multivariate level, since the dependent variable is binary in nature, the binary logistics regression was used to estimate the parameters specified in the behavioural model to determine the relationship between the independent and dependent variables of the study. Households who indicated that their livelihood is disrupted was coded as 1 and household whose livelihood was not disrupted as 0. The objective of the study was to test the degree to which all the variables of interest

influence the dependent variable. Two binary logistic models were run, the first for the flood experience and household livelihood disruption, and the second for the relationship between flood experience and all other independent variables of the study. This fits the model using the equation beneath.

The model was fitted using the formula; $\ln [P1-P] / P = b_0 + b_1x_1 + b_2x_2 + \ldots\ldots\ldots + b_nx_n$

Where; ''P'' refers to the probability of the outcome; ''b'' refers to the constant value; ''b_i'' refers to the estimated coefficients calculated by the maximum likelihood method and ''x_i'' refers to the independent or predictor variables. The binary logistic regression model presents results in beta coefficients which indicates that the expected log-odds on the dependent variable are associated with a unit change in an independent variable. Since all the independent variables in the study were categorized, the use of the binary technique yielded a separate coefficient for each category of the variable. A negative coefficient shows a decreased log odd for those in that category whereas a positive coefficient indicates that the log odds are increased for those in a category relative to the reference category. The outcome is the net impact of each independent variable on household livelihood outcomes. The overall model fit was assessed with the maximum likelihood ratio x^2 statistic.

CHAPTER FOUR
FLOOD EXPERIENCE AND EFFECTS ON HOUSEHOLD LIVELIHOOD OUTCOMES

4.1 Introduction

This chapter presents the results of the descriptive statistics of all the independent variables and the dependent variable provided in the conceptual framework. The results for this chapter are presented in three levels of analysis namely; Univariate, Bivariate, and Multivariate level of analysis.

4.2 Univariate analysis

Information on the univariate level of analysis was presented using descriptive statistics. All the variables were categorical and the factor categories were mutually exclusive which allowed the presentation of the information using tables and appropriate graphical charts.

4.2.1 Background Characteristics of Respondents

A total number of 823 households were included in the analyses and these were those who indicated they had experienced floods in the study area within the last five years out of the total sample frame of 1223. Table 2 below shows the distribution of heads of households by selected background characteristics. The age distribution indicates that a majority (67.7%) of the household heads were aged between 30 - 55 years whilst a lower proportion (13.9%) of the household heads were less than age 30 and 18.5% of them were aged 56 years or more. The majority (69.9%) of household heads were males and this conforms to the nation's statistics. Additionally, a higher proportion (59.9%) of these heads of households were married or currently in union whilst 17.1 % have never married. Concerning the educational attainment of respondents, a higher proportion of the respondents (47.4%) had obtained either a junior secondary school level of education or a

middle school level of education. However, 19.4% of them had below junior secondary school level of education. This is an indication that at least more than half of the proportion included in the study have gained basic level education. Moreover, the employment status of the respondents indicates that a higher proportion of these respondents 47.8% were either paid employees or owned the job. Whilst 20.7 % of them were engaged in casual or domestic work activities as a means of livelihood strategy. With regards to the size of household membership, a majority (66.6%) of these households recorded between 1 to 2 memberships whilst only 8.0% of these households recorded more than 5 memberships. The household wealth group indicates that a slightly higher proportion (33.4%) of the households records a rich wealth status whilst a slightly lower proportion (33.3%) recorded a poor and middle wealth status. Additionally, a higher proportion (43.4%) of the households were residing in buildings with at least 2 blocks higher relative to the community level and only 22.4% were residing in buildings below 1 block elevation relative to the community level.

Also, the tenancy agreement of the households depicts a higher proportion (44.2%) of the households' members were residing in a rented apartment/rooms whilst a lower proportion (13.6%) of these households were residing in apartments/rooms that were rent-free. The constructional materials that were used in the construction of the walls of household residence indicated that 72.2% of the household walls were built with cement or concrete materials whilst 27.8% of the households' walls were built with non-cemented or concrete materials including bamboo, wood/wood planks, plastics, and others. At the level of adaptation, the study included adaptation at both the household and community levels. At the household level of adaptation, a higher proportion (53.9%) of the households were adapting certain strategies such as modification and fixing of the house structure, erection of physical barriers and plant growth as means of reducing flood experience impact on their livelihood outcome whilst 46.1% of these households

were not adopting any of these strategies. However, at the community level of adaptation outcome, a higher proportion (52.0%) of these households were not adapting any strategy in reducing flood experience whilst 48.0% were adapting strategies such as modification and fixing of the house structure, erection of physical barriers, and plant growth as means in reducing flood experience impact on their livelihood outcome.

Table 2 Percent distribution of background characteristics of respondents

Respondents Characteristic	Number	Percent
Age		
Less than 30 years	114	13.9
30 – 55 years	557	67.7
56 years and above	152	18.5
Sex		
Male	575	69.9
Female	248	30.1
Marital Status		
Never married	141	17.1
Married	493	59.9
Formerly in Union	189	23.0
Educational Attainment		
Below JHS	160	19.4
JHS/JSS/Middle	390	47.4
SHS/SSS and beyond	273	33.2
Employment Status		
Domestic/Casual Worker	170	20.7
Self-employed without employees	260	31.6
Paid/Job Owners	393	47.8
Household Size		
1-2 members	548	66.6
3-5 members	209	25.4
More than 5 members	66	8.0
Household Wealth group		
Poor	274	33.3
Middle	274	33.3
Rich	275	33.4

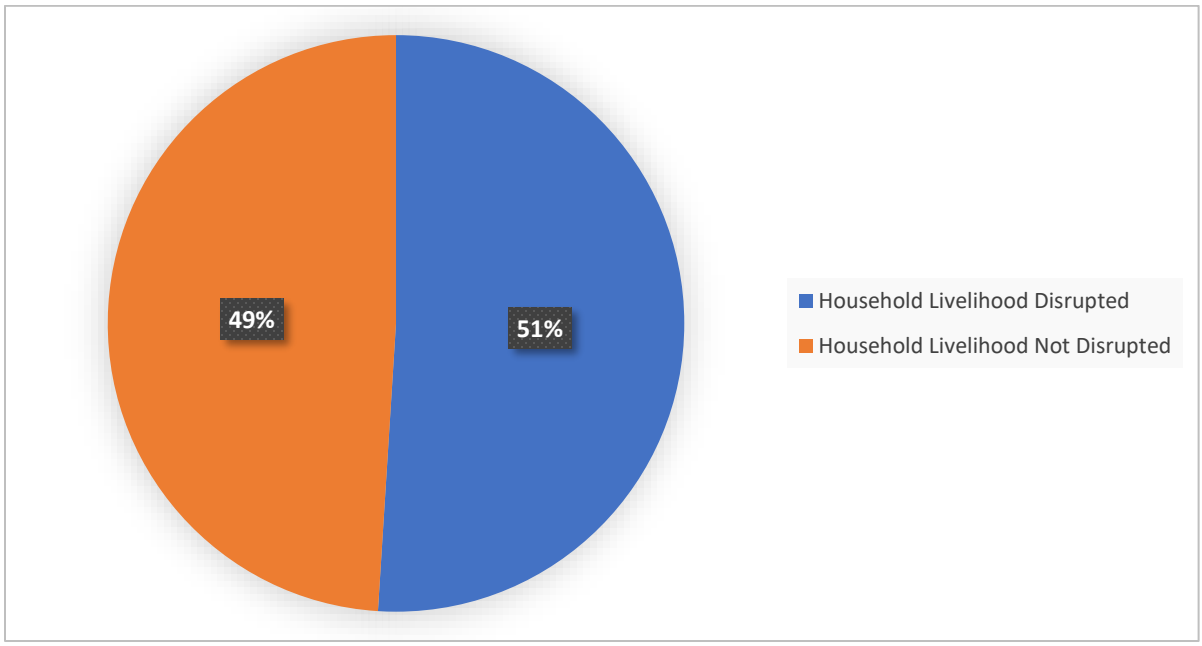
Elevation of the House Relative to the Community Level		
Less than 1 block	184	22.4
1 block	282	34.3
2 blocks or more	357	43.4
Tenancy Agreement		
Owning	347	42.2
Renting	364	44.2
Others	112	13.6
Construction Materials used for Wall		
Cement/Concrete materials	594	72.2
Non-cement / none concrete materials	229	27.8
Household-level Adaptation Outcome		
Not Adapting	444	53.9
Adapting	379	46.1
Community-level Adaptation Outcome		
Not Adapting	428	52
Adapting	395	48
Total	**823**	**100**

Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.2.2 Livelihood disruption in the Greater Accra Metropolitan Area (GAMA)

The dependent variable (Livelihood Outcome) depicts the statistics on the percent of livelihood disrupted and vice versa. At the univariate level of analysis, the livelihood outcome indicates that, out of the 823 (100%) respondents who experience floods, 51% of the livelihoods of these households were not disrupted whilst 49% of these households had their livelihood disrupted.

Figure 5 shows the Household Livelihood Outcome



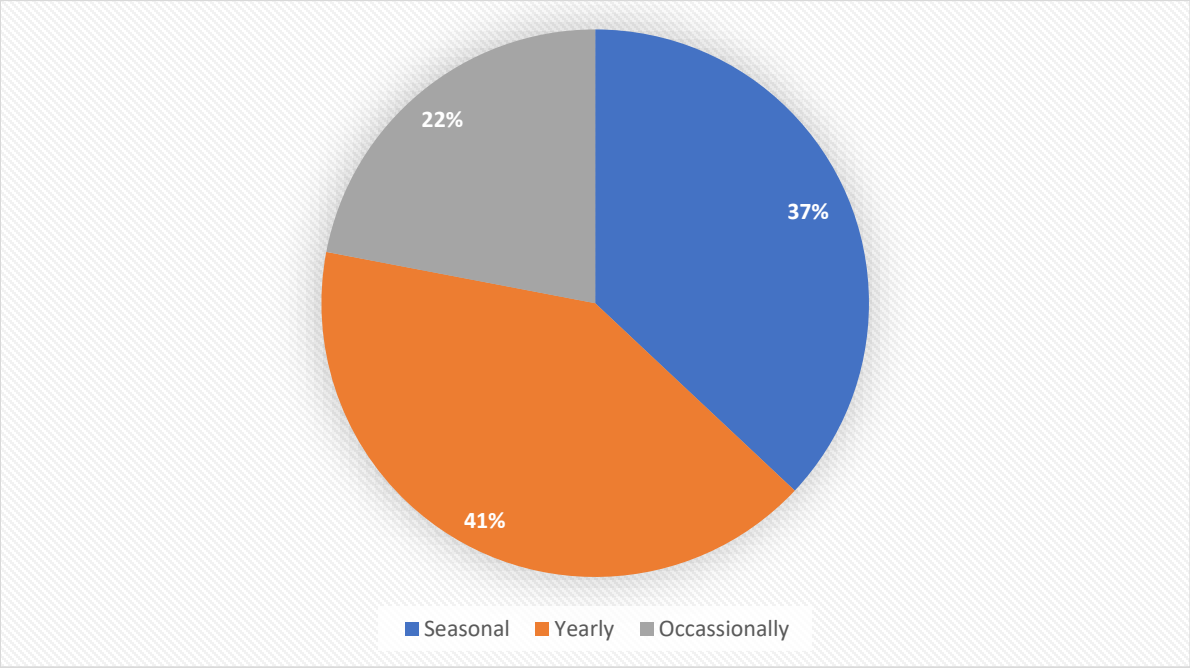
Source: Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.2.3 Flood prevalence and experience in the Greater Accra Metropolitan Area (GAMA)

The Independent variable (Flood experience) presents a level of flood experiences among households in the selected communities within the seven (7) districts in the Greater Accra Metropolitan Area (GAMA). The analysis in figure 5 indicates that, out of the total sample size of 823 respondents who experiences floods, a higher proportion (41%) of them experience floods yearly. This implies an annual flood experience within those households. 37% of the households,

however, admitted that they experience floods any time it rains. This implies a seasonal flood experience within those households. Whilst the remaining 22% of them indicated that they experience floods occasionally. This implies a once-in-a-while flood experience within those households.

Figure 6 shows the Prevalence of Flood Experience in GAMA



Source: Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.2.4 Variations in community flood experience

The variation in the community of location indicated that even though an equal number of households were selected from the 14 communities in the study, the results show that some communities were experiencing floods more than others. The analysis at the univariate level shows that communities such as Tema Community Five and La Agyeman Motom recorded the highest prevalence of flood experiences whereas communities such as Lebanon, Zenu, and Old Tulaku recorded the lowest proportion of flood experiences. The diagram below displays the statistics of the analysis.

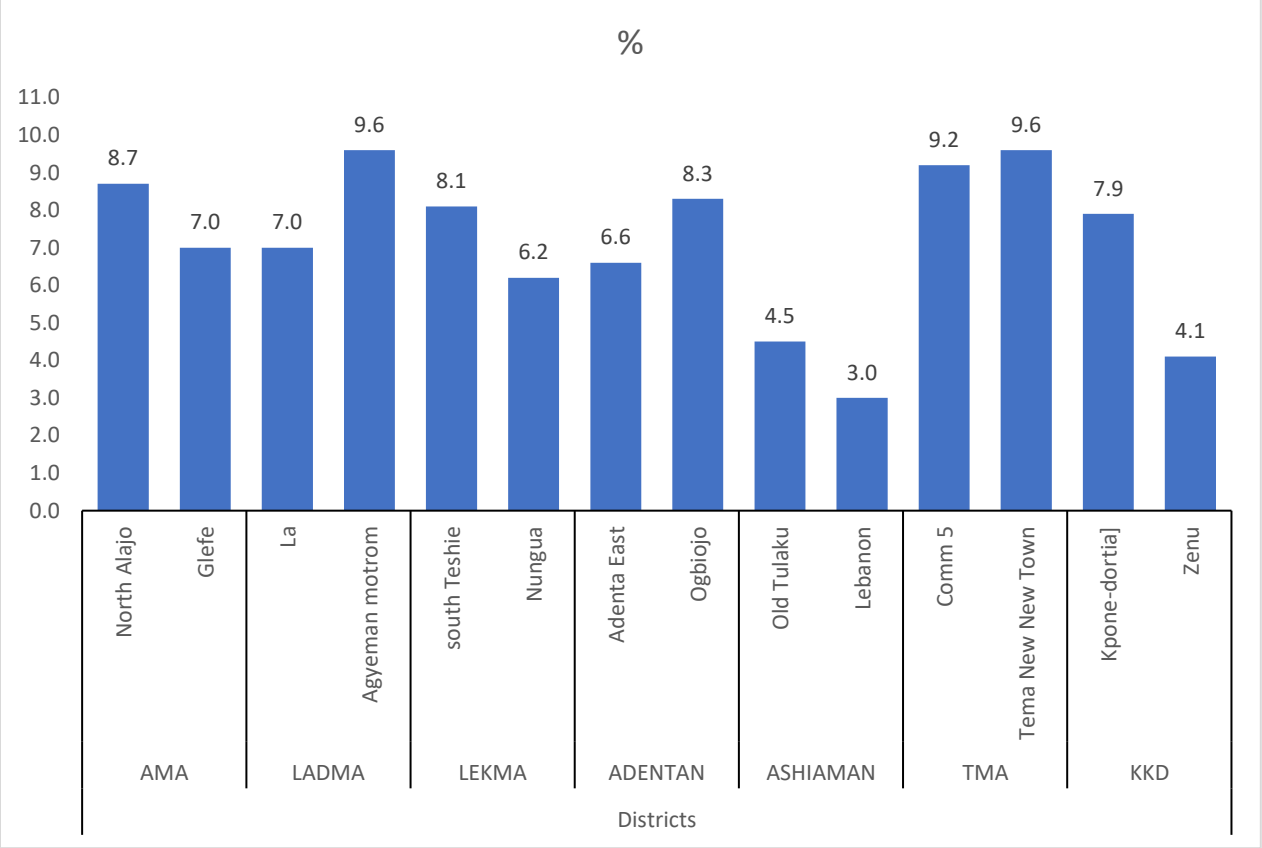
Figure 7 above shows the Variation in Locality Flood Exposure

Source: Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.2.5 District/community of location flood experience

It is observed from figure 7 that out of the seven (7) districts within the Greater Accra Metropolitan Area, interestingly Ashaiman is the district that records the lowest number of flood experiences with Tema Metropolitan recording the highest proportion (18.8%) of flood experiences. Reiterating, the communities that were found to be experiencing floods within Tema were the Tema New Town area and Tema Community Five whereas communities such as Old Tulaku and Lebanon in the Ashiaman district recorded the lowest flood experience within the Greater Accra Metropolitan Area (GAMA).

Figure 8 shows the District/Community of Location Flood Experience



Source: Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.3 Association between each of the independent variables and livelihood disruption

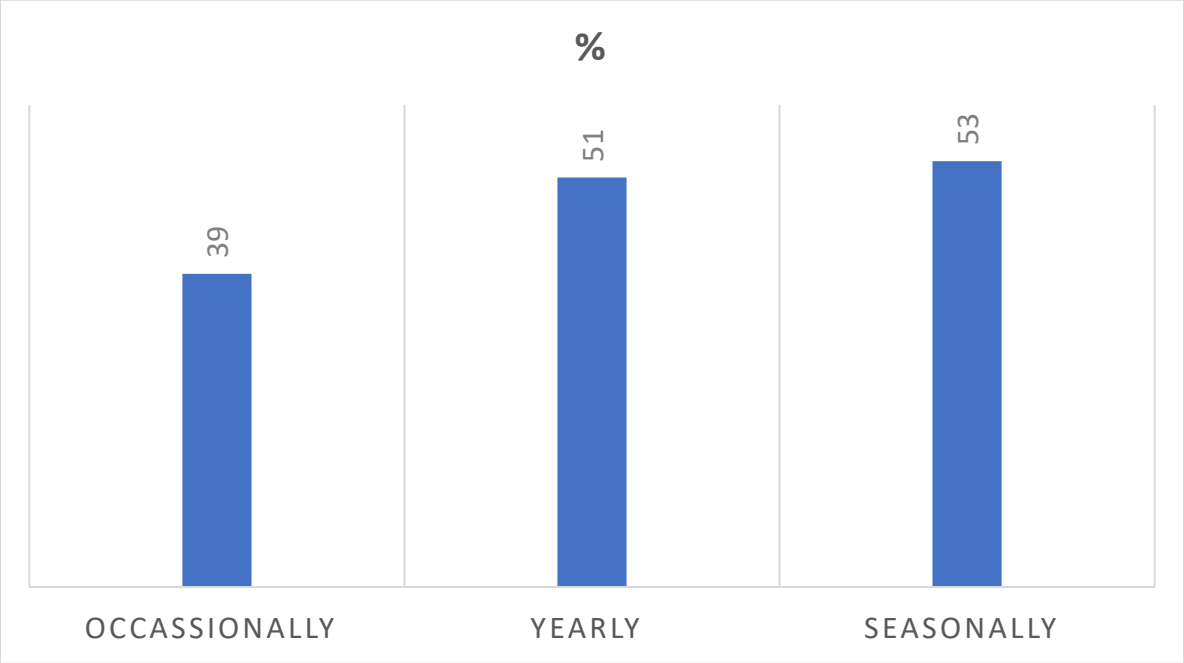
This section examines the relationship between each of the independent variables and livelihood disruption using cross-tabulations and the chi-square test of significance. The independent variables include; flood experience, age, sex, marital status, educational attainment, employment status, household size, wealth group, the elevation of the house relative to the community level, district of residence, communities of residence, construction materials used for walls, household-level of adaptation and community level of adaptation. In measuring the relationship between respondents' background characteristics, flood experience, and livelihood outcome, Pearson Chi-square test statistics were computed for each of the independent variables and the dependent variable with reference to an alpha value of 0.05 significance level or 95% confidence interval. A chi-square test statistical value below $p < 0.05$ indicates a significant relationship between the two variables. A significant relationship between the two variables implies that a change in one or the other variable significantly relates to either an increase or a decrease in the second variable. Each of the tests of associations is presented in detail below.

4.3.1 Flood experience and livelihood disruption

The results show that the frequency or level of flood experience is positively related to livelihood disruption. Among households that reported experiencing flood every time it rained (seasonally) 53 % of them had their livelihoods disrupted compared to 39 % of those who experience floods occasionally. Reiterating, the study hypothesized that ''Households who experience floods seasonally are more likely to have their livelihood disrupted compared to households who experience floods occasionally''. This implies that households that experienced floods seasonally are the most vulnerable group to livelihood disruption due to the higher exposure of flood

experiences. The asymptotic chi-square test of independence value (P-value = 0.011) shows a significant relationship between flood experience and household livelihood disruption. This indicates that the level of flood experience is associated with household livelihood disruption. Households that are more prevalent in floods have higher odds of livelihood disruption compared to households that experience floods occasionally.

Figure 9 Flood experience and household livelihood disruption



Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.3.2 Educational attainment and livelihood disruption

The role of education is a major determinant in the activities of humans. Moreover, education plays a vital role in the transfer of knowledge from one individual to another through generations of the human population. Individuals with a higher educational level of attainment are usually expected to have a positive influence on a variety of issues such as the application of knowledge either in solving or mitigating the impacts of flood experiences on their livelihood outcomes.

This study again hypothesized that ‘‘Respondents with below Junior High School educational attainment are more likely to have their livelihood affected compared to respondents with Senior High School educational attainment’’. This implies that well-educated people are more gainfully employed and have enough resources to reside in less vulnerable places to prevent flood occurrences from disrupting their livelihoods. Additionally, well-educated persons may be able to apply some kind of mitigation strategies that tend to remedy their livelihood outcome. Results from Table 3 indicates that educational attainment is significant (p-value <0.005) with livelihood outcome at a 95% confidence level. The results indicate that a majority of the respondents (60.6%) who had their livelihood affected obtain below Junior High School educational level. These groups of respondents are those with the lowest education attainment level in the study. Meanwhile, respondents with Junior High School (JHS) or Middle School and beyond educational attainment recorded 53.8% of their respondents having no livelihood affected. The educational attainment of respondents is, therefore, a significant influence on the livelihood outcome of respondents in the study.

Table 3 Percent distribution of educational attainment of heads of households and their livelihood disruption

Educational Attainment	Livelihood disrupted Percentage (%)	Number
Below JHS	60.6	160
JHS/Middle	46.2	390
SHS and beyond	46.2	273
Total	**49.0**	**823**

χ^2 = 10.802 df=2 p-value = 0.005

Source: Computed from the Cities and Climate Change Dataset (2017), September 2020

4.3.3 Employment status and livelihood disruption

Table 4 shows the employment status of household heads and their association with their livelihood outcome. Literature has proved that; the employment status of a household is a determinant factor in influencing their livelihood outcome.

Owing to this point, the variation of livelihood outcomes may exist due to the employment status of different household heads. The chi-square test statistics indicate that employment status has a highly significant association with livelihood disruption. The chi-square p-value is < 0.001 which indicates a strong relationship between the employment status of household heads and livelihood outcomes.

The results presented in Table 4 below show that a majority (60.6%) of the households who had no livelihood affected were either Domestic or Casual workers whilst 46.2% of the respondents who had their livelihood affected were either self-employed workers without employees or paid/job owners. Reiterating, this implies that, a higher proportion of respondents who have their livelihood affected are usually residents who either engage in petit trading activities or sole proprietorship type of business without employees.

Table 4 Employment status of respondents and livelihood disruption

Employment Status	**Livelihood disrupted Percentage (%)**	**Number**
Domestic/Casual	60.6	170
Self-employed without employees	46.2	260
Paid/Job owners	46.2	393
Total	**49.0**	**823**

χ^2 = 36.553 df=2 p-value = 0.001

Source: Computed from the Cities and Climate Change Dataset (2017), September 2020

4.3.4 Wealth group and livelihood disruption

This study hypothesized that ‘‘households in the poor wealth group are more likely to have their livelihood disrupted compared to households in the rich wealth group’’. The prediction is that households with high wealth status are more likely to have improved proper waste management practices, the regular distillation of drains or are even in the capacity to be able to afford construction materials that can help mitigate the impact of flood experiences on their livelihood outcome.

An analysis of the data shown in table 5 disclosed that a higher proportion (50.6%) of the households in the poor wealth group had their livelihood disrupted as compared to at least 35% of households in the rich wealth group with their livelihood disrupted. It can be concluded that respondents in the poor wealth group are not in the capacity to be able to afford better measures such as paying for proper waste management practices, paying for a regular distillation of their drains, or even not in the capacity to able to afford good constructional materials that tend to mitigate the impact of flood experiences on their livelihood outcome.

At the 95% confidence level, this study found a significant (p-value <0.001) association between households’ wealth group and their livelihood outcome in the Greater Accra Metropolitan Area (GAMA). The significant association between household wealth status and livelihood disruption as revealed by the study is to be expected. This is because the household wealth group is an important factor in determining the lack of or access to materials and properties that can be used in reducing the impact of flood experiences on livelihood outcomes.

Table 5 Relationship between households' wealth group and livelihood disruption

Wealth group	Livelihood disrupted Percentage (%)	Number
Poor	55.5	274
Middle	51.8	274
Rich	39.6	275
Total	**49.0**	**823**

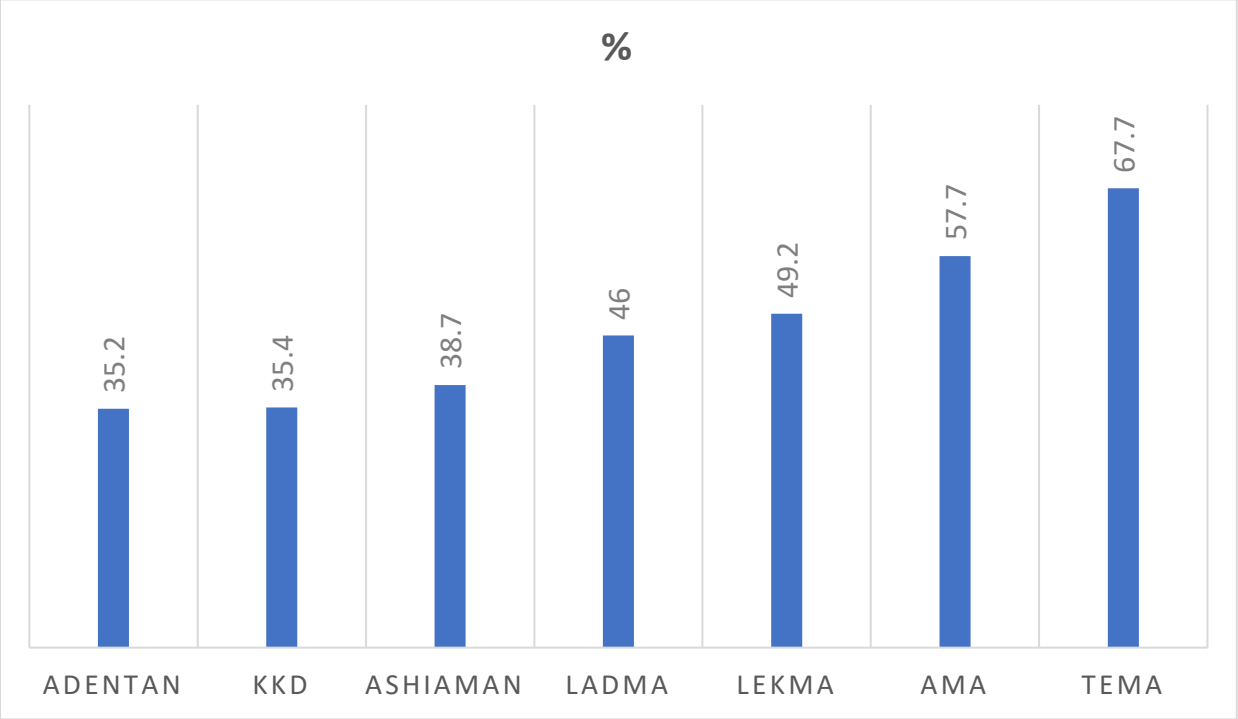
χ^2 = 19.610 df=4 p-value = 0.001

Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.3.5 District of residence and livelihood disruption

Figure 7 shows the percentage distribution of the residential district of respondents and their respective livelihood outcomes. The district of residence records a significant p-value of 0.00 which implies that the district of residence is significantly correlated to the livelihood outcome of households. Reiterating, based on the district of residence of households, the chance of possible livelihood disruptions due to flood experiences. Additionally, Tema Metropolitan which recorded the highest proportions (16.8%) of flood experience resulted in having a majority (67.7%) of their respondents having their livelihoods disrupted by floods. Moreover, it is interesting to note that, the Ashaiman municipal district which previously recorded a lower proportion of flood experience, however, the impact on their household livelihood disruption was higher (38.7%) as compared to districts such as Adenta (35.2%) and Kpone Katamanso (35.4%) that recorded higher proportions of flood experiences respectively. It is, therefore, imperative to note that, the district of residence has a significant influence on flood experiences and livelihood outcomes.

Figure 10 District of residence and livelihood disruption

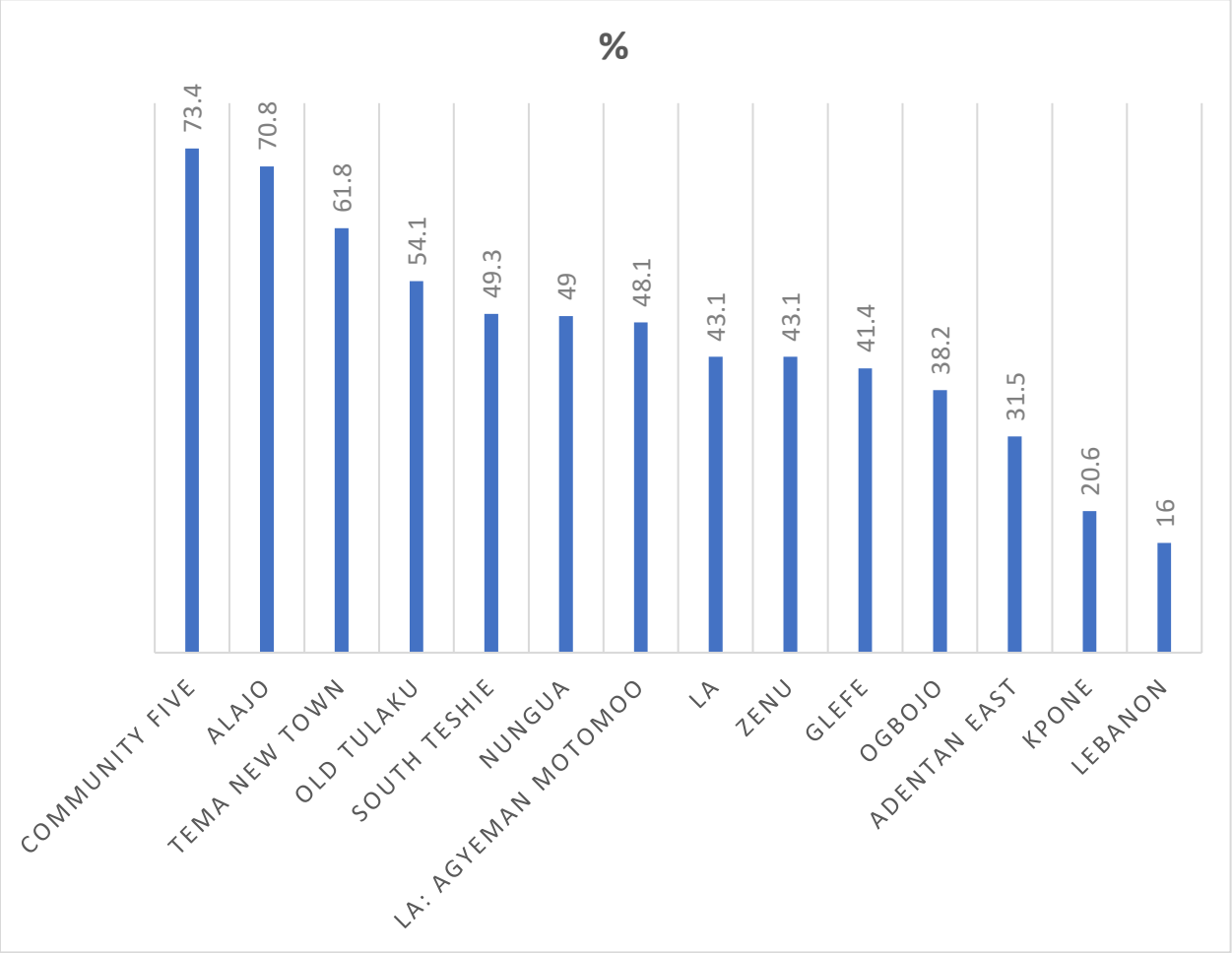


Source: Computed from the Cities and Climate Change Dataset (2017), September 2020)

4.3.6 Community of residence and livelihood disruption

Figure 8 shows the relationship between the community of residence and livelihood outcome. The results indicate that there is a highly significant association between the household community of residence and livelihood outcome in the Greater Accra Metropolitan Area (GAMA). Results from the analysis show that households that reside in communities such as Tema New Town and Community Five within the Tema Metropolitan Area recorded the highest of 73.4% and 61.8% of their household's livelihood disrupted respectively compared to communities such as Lebanon/Jericho and Zenu within the Ashaiman Municipality. This implies that the geographical location of a household can determine whether or not the household would have their livelihood disrupted as a result of their flood experience.

Figure 11 Community of residence and livelihood disruption



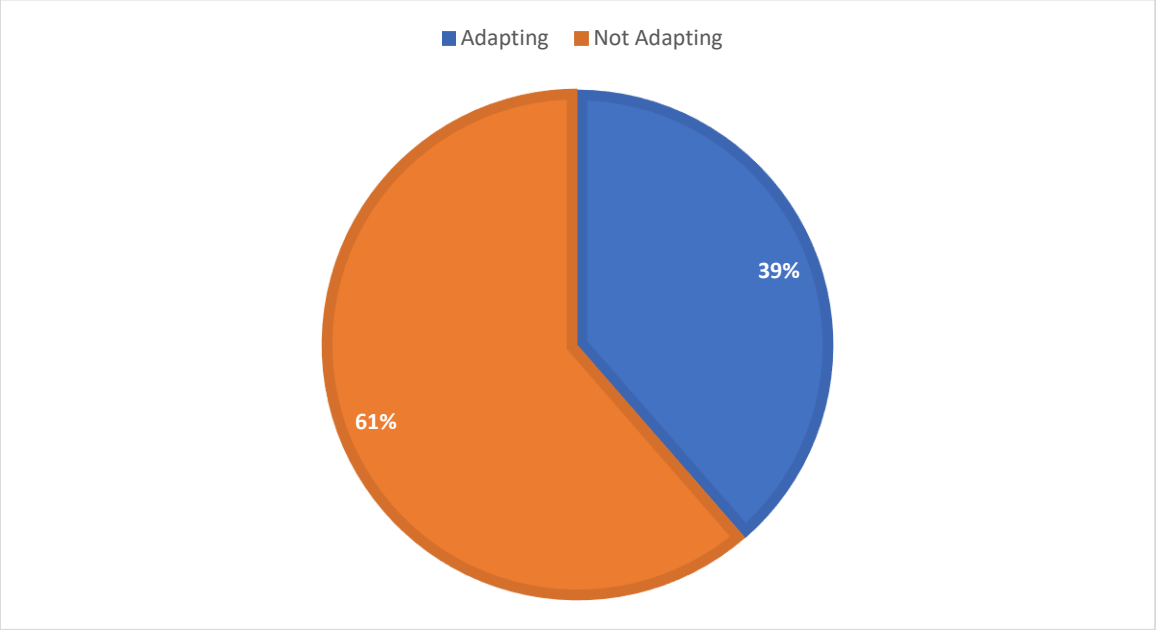
Source: Computed from the Cities and Climate Change Dataset (2017), September 2020

4.3.7 Household-level adaptation and livelihood disruption

The association between the household level adaptation and the livelihood disruption of households was found to be highly significant with a p-value of 0.01 at the 95% confidence level. The study hypothesized that ‘‘Households who were adapting at the household level are less likely to have their livelihood disrupted compared to households who were not adapting at the household level’’. However, it was interesting to note that out of the 823 households who experience floods, households that were adapting recorded a majority (61.2%) of their livelihood disrupted whereas only 38.5% of the households who were not adapting had their livelihood disrupted. The adaptation

strategies used at the household level included whether the households had modified or fixed a structure to reduce their flood experience or whether the household had planted trees or erected a physical structure as a means of reducing their flood experiences. Households that had adopted any of the above were said to be adapting whereas households who had not used any of the above were noted as not adapting. These results indicate that households that were adapting at the household level consider themselves vulnerable to flood disasters and were therefore taking all necessary steps in reducing their vulnerability. This accounts for the variation between household-level adaptation and livelihood disruption.

Figure 12 Household-level adaptation and livelihood disruption



Source: Computed from the Cities and Climate Change Dataset (2017), September 2020

4.4 Multivariate level of analysis: flood experience and livelihood disruption

The binary logistics regression conducted two models at the multivariate level of analysis. Model 1: Estimation of flood experience using livelihood outcome was used to predict the influence of

the independent variable (flood experience) on the dependent variable (Livelihood outcome). The second model estimates then used the main independent variable (Flood experience) together with the other independent variables of the study with the dependent variable (Livelihood Outcome) to examine the influence of the main independent variable (level of flood experience) controlling for all other independent variables.

For independent categorical variables, one factor or category is used as the reference with which all others. The probability that, an individual livelihood will be affected is interpreted with the help of odd ratios. An odds ratio that is greater than one increases the chance of an individual livelihood disrupted compared to the reference category whilst an odds ratio less than one decreases the chance of an individual household livelihood disruption. Significant predictor variables were measured to predict the livelihood disruption of respondents using the p-value <0.05 as standard.

4.4.1 Model 1: estimation of flood experiences on household livelihood disruption

The model presents a binary logistic regression analysis of the independent variable (flood experience) measured as occasionally, yearly, and seasonally as against the dependent variable (livelihood disruption). The model is found to be statistically significant at p= 0.01 at a 95% confidence level.

The results indicate the model has distinguished clearly, respondents who experience floods, and the odds of these respondents' chances of their livelihood disruptions. Nagelkerke's R^2 value of 0.02 explains the variations in livelihood disruption. The overall group classification prediction outcome was 54.0%. Whereas the Hosmer and Lemeshow (H-L) goodness-of-fit test was at a 1.000 level of significance which indicates that it is not statistically significant and thus the model estimates fit the data at an acceptable level and hence the model is a good fit.

The results in the model show that level of flood experience was a significant predictor variable on household livelihood disruption at p=0.01 level of significance. Households that experience floods anytime it rains (seasonally) were 1.73 times as likely to have their livelihood disrupted compared to households that experience floods occasionally. Additionally, households that experience floods yearly were 1.60 times as likely to have their livelihood disrupted compared to households that experience floods occasionally. This indicates that households that experience floods anytime it rains (seasonally) and households that experience floods yearly were more vulnerable to livelihood disruption compared to households that experience floods occasionally.

4.4.2 Model 2: estimation of flood experiences on livelihood disruption controlling for all the other variables

Model 2 involves an assessment of the independent variable (flood experience) and the dependent variable (livelihood outcome) controlling for all the other variables in the study. These variables include; age, sex, marital status, education, employment status, household size, wealth group, the elevation of the house, tenancy agreement, district, materials used for wall, household-level adaptation, and community-level adaptation. The results indicate that the overall model is significant with a chi-square value of 180.42 with 28 degrees of freedom (df). The addition of all the other independent variables yielded a better fit and the model predicts 69% of the correct classification table with Nagelkerke's R^2 value of 0.26. Detailed information on the model is presented in the table below.

Table 6 Model estimation of flood experiences on livelihood disruption controlling for all the other independent variables

INDICATOR VARIABLES	LIVELIHOOD DISRUPTED			
	Model 1		Model 2	
	OR, 95% CI	P-Value	OR, 95% CI	P-Value
FLOOD EXPERIENCE				
Seasonally	1.73 [0.19,2.51]	0.01	1.40 [0.907,2.19]	0.14
Yearly	5.60 [1.11,2.31]	1.60	1.89 [1.21,2.94]	0.01
Occasionally (R.C)	1.00	0.01	1.00	0.02
AGE				
Less than 30 years			0.97 [0.58,1.60]	0.89
30-55			0.78 [0.38,1.49]	0.41
56+ (R.C)			1.00	0.62
SEX				
Male			1.25 [0.82,1.90]	0.31
Female (R.C)			1.00	
MARITAL STATUS				
Married / Living together			0.82 [0.51,1.34]	0.40
Formerly in Union			1.34 [0.76,2.39]	0.31
Never Married (R.C)			1.00	0.11
EDUCATION				
Below JHS			1.34 [0.82,2.19]	0.24
JHS/Middle			0.95 [0.66,1.37]	0.78
SHS and above (R.C)			1.00	0.30
EMPLOYMENT STATUS				
Domestic/Casual worker			0.28 [0.17,0.46]	0.01
Paid/Job Owners			0.44 [0.30,0.66]	0.01
Self-employed without employees (R.C)			1.00	0.01

HOUSEHOLD SIZE				
1-2 Members			0.65 [0.35,1.20]	0.17
3-5 Members			0.65 [0.34,1.21]	0.17
More than 5 Members (R.C)			1.00	0.36
WEALTH GROUP				
Poor			1.29 [0.81,2.04]	0.29
Middle			1.39 [0.93,2.08]	0.11
Rich (R.C)			1.00	0.27
ELEVATION OF HOUSE				
Less than 1 Block			0.49 [0.32,0.74]	0.01
1 Block			0.80 [0.56,1.15]	0.23
2 Blocks or more (R.C)			1.00	0.01
TENANCY AGREEMENT				
Others			0.92 [0.63,1.33]	0.65
Renting			1.05 [0.63,1.74]	0.86
Owning (R.C)			1.00	0.82
DISTRICT				
AMA			3.67 [1.76,7.71]	0.01
LaDMA			1.40 [0.68,2.89]	0.36
LeKMA			2.31 [1.09,4.89]	0.03
Adenta			0.72 [0.34,1.54]	0.40
TMA			2.43 [1.20,4.90]	0.01
KKD			1.10 [0.52,2.34]	0.81
Ashaiman (R.C)			1.00	0.01
MATERIALS USED FOR WALL				
Cement /Concrete materials			0.45 [0.29,0.72]	0.01
Non-cement/ non-concrete materials (RC)			1.00	

HOUSEHOLD-LEVEL ADAPTATION				
Not Adapting			0.38 [0.28,0.53]	0.01
Adapting (RC)			1.00	
COMMUNITY-LEVEL ADAPTATION				
Not Adapting			1.19 [0.86,1.64]	0.30
Adapting (RC)			1.00	
Nagelkerke's R2	**0.02**		**0.26**	
Model Chi (df) Sig	**9.14 (2)**	**0.01**	**180.42 (28)**	**0.01**

Source: Computed from the Cities and Climate Change Dataset (2017), September 2020

Results from the model presented above indicate that age, sex, marital status, education, household size, wealth group, tenancy agreement, and community-level adaptation outcome were not significant predictors of livelihood disruption. Meanwhile, variables such as educational attainment and wealth group were significant predictor variables at the bivariate level of analysis but when put in the model controlling for other factors the results indicated an insignificant association between educational attainment and wealth group on livelihood disruption.

The results from the model above indicate that flood experience among households is a significant predictor of livelihood disruption at p= 0.01 at the 95% confidence level. Meanwhile, households that experienced floods seasonally was not a significant predictor on livelihood disruption at p=0.14. Even though households who experience floods seasonally was not a significant predictor when controlling for the others, the results from the model, however, indicate that households who experienced floods yearly were 1.89 times as likely to have their livelihood disrupted compared to households who experience floods occasionally. This is an indication that households who experience floods yearly are more vulnerable to livelihood disruption compared to households that

experience floods occasionally because the prevalence of floods experiences influences the severity of livelihood disruption.

With regards to the age of household head, age was not a significant predictor of livelihood disruption at p=0.62. This implies that the age of a household head is not associated with livelihood disruption. Additionally, the sex of the household head was not also a significant predictor variable on livelihood disruption. The sex of the household head was insignificant at 0.31. This means that the sex of a household head does not influence whether or not the household would have their household livelihood disrupted by floods. Again, the marital status of the household head was not also a significant predictor of livelihood disruption at the multivariate level of analysis at p=0.11. Moreover, the educational attainment of the household head though was significant at the bivariate level of analysis, the results at the multivariate analysis indicate that the educational attainment of the household does not play a significant role in influencing whether or not a household would have their household livelihood disrupted. Educational attainment was insignificant at p=0.30. The employment status of the household head was, however, a significant predictor of livelihood disruption at p=0.01 at a 95% confidence level which signifies that the employment status of the household head has a strong relationship with their livelihood disruption.

Moreover, results on household heads who are domestic or casual workers indicate that domestic or casual workers are 0.28 times as likely to have their livelihood disrupted compared to household heads who are self-employed without employees. Additionally, household heads who are paid or job owners are 0.44 times as likely to have their livelihood disrupted compared to households' heads who are self-employed without employees. The results depict that, household heads who are domestic or casual workers have less chance (0.28) of having their household livelihood disrupted whereas those who owned the jobs or were paid workers have a slightly higher chance (0.45) of

having their livelihood disrupted. This is because they would have lost more assets due to flood experience and since they own the property, they would incur a cost in revamping whilst casual or domestic workers have alternatives should their main economic activity get disrupted.

On the other hand, household size was not a significant predictor variable on livelihood disruption at 0.36. This indicates that the number of members in a household does not influence whether or not the household would have their livelihood disrupted by floods. Additionally, the wealth group which was significant at the bivariate level came out as an insignificant predictor variable at the multivariate level when all the other variables were controlled at p=0.27. This shows that there is no association between household wealth groups and household livelihood disruption.

The elevation of the house relative to the community although was insignificant at the bivariate level of analysis came out as a significant variable at the multivariate level of analysis controlling for all the other independent variables at a strong (0.01) significance level. This implies that the elevation of household houses plays a significant role in determining whether or not these households would have their household livelihood disrupted. Households that raised their houses by 1 block (6 inches) were 0.80 times as likely to have their livelihood disrupted compared to households that raised their building by 2 or more blocks relative to the community level. However, though households with an elevation of their houses lower than 1 block was not a significant predictor of household livelihood disruption, the results indicate that these households were 0.49 times as likely to have their household livelihood disrupted by floods compared to the households with their house elevation above 1 or more blocks.

Concerning the tenancy agreement of households, the results show that the tenancy agreement was not a significant predictor variable on household livelihood disruptions at p=0.82. This illustrates that there is no association between the tenancy agreement and household livelihood disruption.

This means that it does not matter whether a household was residing in a rented apartment or owned apartment, there is no relationship between the tenancy agreement and whether or not the household would have their household livelihood disrupted by floods.

The district of residence was, however, a highly significant predictor of livelihood disruption with a p-value of 0. 001. Apart from LADMA, Adenta, and KKD, all the other categories of the district were a significant predictor of the household livelihood disruption in the Greater Accra Metropolitan Area (GAMA) at the multivariate level of analysis controlling for all the other independent variables. Households within Accra Metropolitan Area (AMA) were 3.67 times as likely to have their livelihood disrupted compared to households within the Ashiaman municipality. Moreover, households within LEKMA were 2.31 times as likely to have their livelihood disrupted compared to households within the Ashiaman municipality area. Lastly, households within Tema Metropolitan were 2.43 times as likely to have their household livelihood disrupted by floods compared to households within Ashiaman. This shows that, though households within selected communities (Community five and Tema New Area) in Tema recorded the highest flood experience, the disruption on household livelihood indicated that, households within Accra Metropolitan Area recorded more damages on their livelihood than the selected communities in Tema. Again, communities in LEKMA are 2.31 times likely to have their livelihood disrupted by floods compared to households within selected communities in the Ashiaman municipality.

The materials used for the construction of the household wall was a significant predictor of household livelihood disrupted at 0.01. This signifies that there is an association between the materials household used in building their walls and household livelihood disruption. Households with cemented materials used in wall construction were 0.45 times as likely to have their household livelihood disrupted compared to households with non-cemented materials. In furtherance,

household-level adaptation outcome was a significant predictor of household livelihood disruption at the 0.01 significance level. Households that were not adapting are 0.38 times as likely to have their household livelihood disrupted by floods compared to households that were adapting. This is an indication that the household level of adaptation determines their level of household livelihood disruption. Households that were adapting considers themselves very vulnerable to flood disasters and for that reason were adapting to help reduce the impact of flood experience on their household livelihood outcome. At the community level of adaptation, however, the model results show no association between community-level adaptation and household livelihood disruption. This implies that the community level adaptation does not play a vital role in determining the household livelihood of residents in the selected communities within the Greater Accra Metropolitan Area (GAMA).

4.5 Discussion of results

This section provides a brief discussion of key findings while comparing findings with previous studies. Discussions in this section are mainly centred on the objectives of the study, the study hypotheses, and comparisons made to other research work on flood experience and livelihood outcomes.

The first objective of the study was to describe the prevalence and severity of flood experiences among households within the Greater Accra Metropolitan Area (GAMA). Guided by this, the univariate level of the analysis indicated that, majority (78%) of households' experience floods yearly. The severity of floods is dependent on the prevalence of flood experiences. Households that experienced floods anytime it rained (seasonally) were reported to have encountered a higher proportion of livelihood disruption compared to their households' counterparts that experienced

floods occasionally. However, the prevalence and severity of flood experience may not only be linked to livelihood disruption but can as well be associated with depression among flood victims. A study conducted by Thomas et al. (2019) indicated that a significant number of households who experienced floods frequently showed signs of depression. This, therefore, calls for an intervention to help improve the mental health status of flood victims.

The second objective of the study was, to assess the possible relationship between flood experience and livelihood disruption and other related factors. At the bivariate level of analysis, flood experience and household livelihood outcomes were significant at 0.011 at a 95 % confidence level. This implies that the flood experience of households can either or not determine whether the household would have their livelihood disrupted or not. Results from this study indicated that a higher proportion of the households that indicated that they experience floods anytime it rained (seasonally) were the most vulnerable group that had their household livelihood disrupted. The households that experience floods seasonally were the most vulnerable group because these are households that are predominantly exposed to floods. Reiterating, it was earlier stated in the first objective that, the prevalence of flood experience influences the severity of flood disasters. In furtherance, a study conducted by Armah et al. (2010) indicated that there is an association between flood experience and economic livelihood cost. Reiterating, the study showed that the respondents who experienced floods had their livelihood activities such as fishing boats, physical assets, jobs, and income disrupted as a result of flood experiences. Consistent with the finding, this study has, therefore, revealed that there is an association between flood experience and livelihood outcome.

The multivariate level of analysis using the binary logistic regression model indicated that respondents who had below Junior High School education were 1.34 times as likely to have their

livelihood disrupted compared to respondents with Senior High School or above education. This implies that education indeed plays a vital role in the livelihood outcome of households. Households with more educated members are most likely to be in the capacity of adapting to prevent their vulnerability. This result is consistent with a study done by Jabeen et al. (2010) which indicated that education plays a role in job security. Educated persons are in the position of securing jobs that earn them money compared to non-educated people. Additionally, households with more educated members would be in the capacity to be able to secure jobs that elevates their wealth status and puts them in the capacity to be able to afford some kind of adaptation strategies that can help minimize their household flood experiences and their impact on their livelihood outcomes.

At both the bivariate and multivariate level of analysis, employment status was a significant predictor of livelihood outcome which indicates that the employment status of a household head has an association with their livelihood outcome. Reiterating, household heads who were domestic or casual workers were 0.28 times as likely to have their livelihood disrupted compared to household heads who were self-employed without employees. This implies that respondents who were self-employed without employees were more vulnerable to losing their jobs in case of flood experiences compared to those engaged in casual or domestic work. Chances are that those household heads engaged in casual or domestic work can always find another work should their previous work be disrupted by floods. However, self-employed respondents would suffer a lot of consequences due to flood disasters and may not be in the capacity to be able to get another job due to the loss of financial and physical assets.

Again, the study at the bivariate level indicated that the household wealth group was a significant predictor variable on livelihood outcomes. This implies that the household wealth group status

influences livelihood outcomes. As expected, households that are in the poor wealth group would not be able to afford some kind of mitigation structures such as modifying their house structures or erecting trees/materials used as a mechanism to reduce flood experience. Therefore, these households would be more vulnerable to flood experience and would have more of their livelihood disrupted due to their inability to purchase adaptive mechanisms to protect them from flood disasters. However, households in the rich wealth group on the other hand would be able to adapt some kind of adaptation strategies such as raising their buildings with 1 or 2 blocks relative to the community level, modifying their house structures, or even erecting trees as a way of reducing their flood experience and its impact on their livelihood disruption.

The geophysical location of a household was highly significant indicated of flood experience and livelihood disruption. The district of residence of the household was associated with livelihood disruption. This implies that households' geophysical location can either or not influence whether their livelihood would be disrupted by floods. This study indicated that, among the seven (7) districts within the Greater Accra Metropolitan Area (GAMA), communities such as Tema New town and Tema community five (5) recorded the highest proportion of flood experiences compared to communities such as Lebanon/Jericho in the Ashiaman municipality. This is a result of the geophysical location of these communities. Communities such as Tema New Town and Community five are coastal lands that predispose them to the occurrence of floods during high tides. Whereas communities such as Lebanon/Jericho are inland and are geographically higher in elevation compared to the communities within the coast. However, at the bivariate level of analysis, even though communities within the Ashiaman municipality had recorded the lowest proportion of flood experiences, a higher proportion of the households within Ashiaman recorded

relatively high livelihood disruption compared to communities within Adentan municipality and Kpone-Katamanso District areas.

The study indicated that households residing in structures built with cement or concrete materials were rather surprisingly having a higher proportion of their household livelihood disrupted compared to those residing in non-cemented or non-concrete materials. These non-cemented or non-concrete materials used for wall construction included materials such as thatch, bamboo, wood/wood planks, and containers. The reason why households residing in houses built with non-cemented or concrete materials were having their household livelihood disrupted is that these households consider themselves vulnerable to flood disasters, and because of their vulnerability, these households then decide not to purchase livelihood assets that could easily be disrupted by floods. Additionally, these higher proportion of the households residing in structures built with non-cemented or concrete materials are found mostly in the poor and middle wealth group which hinders them financially and puts them in a capacity of not being able to afford some livelihood assets. This result is consistent with a study conducted by Rufat et al. (2015) which illustrated that the socio-economic characteristics of households influence the type of residential structures they reside in. Wealthy households reside in cement or well-constructed concrete houses whereas the poor households reside in wooden or thatch structures increasing their vulnerability.

At both the bivariate and multivariate levels of analysis, the household level adaptation outcome variable was a significant predictor of household livelihood outcomes. Interestingly, households that were adapting were rather recording a higher proportion of their livelihood disrupted compared to households that were not adapting. The reason is that a higher proportion of the households that were adapting were households that experiences floods anytime it rains (seasonally). These households consider themselves vulnerable to flood disasters and were,

therefore, taking certain adaptive measures in reducing their flood experience impact on their household livelihood outcome. However, these households recorded a higher proportion of their livelihood disrupted. The reason is that these households were not adapting the best adaptation measures which are, therefore, accounting for their continuous flood experiences.

CHAPTER FIVE
SUMMARY, CONCLUSION, AND RECOMMENDATION

5.0 Introduction

This chapter is divided into three sub-sections namely; summary, conclusion, and recommendation. The chapter provides a summary of the key findings of the study, a conclusion based on the findings of the study, and lastly policy and research recommendations to guide future works and studies in the area of flood experience and livelihood outcomes.

5.1 Summary

The objective of the study sought to describe the prevalence and severity of flood experience among households within the Greater Accra Metropolitan Area (GAMA). The study also sought to examine the relationship between the severity of flood experience and household livelihood disruption. Household livelihood outcome was derived after computing several other variables that measured livelihood assets using financial and physical assets. Households who reported damages from either their physical or financial assets were said to have their household livelihood disrupted.

The main independent variable used to assess the household livelihood outcome was flood experience. The inclusion criterion for the study was, therefore, based on only households that experience floods either occasionally, yearly, or seasonally. Households that did not experience floods were excluded from the study. With the view of comparing findings with other studies, three levels of analyses; univariate, bivariate, and multivariate were carried out. Univariate analyses were done to show the socio-economic, demographic, and geographic distribution of the households' characteristics. Bivariate analysis through the Pearson chi-square test of association was conducted to examine the relationship between each of the independent variables and

household livelihood disruption. At the multivariate level, the binary logistic regression model was used to examine the associated factors of household livelihood disruption at the 95% confidence interval.

Evidence from the study showed that 78% of the households within districts in the Greater Accra Metropolitan Area (GAMA) experiences floods yearly and seasonally which indicates that floods experience among the study population were prevalent.

At the bivariate level of analysis, household background characteristics were tested using a chi-square independent test. Results from the study showed that age of household head, sex, marital status, household size, elevation of the house relative to the community, tenancy agreement, and community level adaptation outcome were found not to be significant predictor variables on the household livelihood outcomes. Whereas educational level, employment status, household wealth group, district, communities, materials used for wall construction, and household level adaptation were found to be significantly associated with household livelihood disruption.

At the multivariate level, the study further conducted a binary logistic regression model analysis to identify the most significant predictors of household livelihood disruption. The model revealed employment status, the elevation of the house relative to the community level, district, materials used for wall construction, and household level adaptation were significant predictor variables of household livelihood disruption.

Lastly, discussions on the findings show that flood experience among residents in the study area was prevalent. Additionally, the households that were more exposed to flood experiences recorded a higher percentage of livelihood disruption compared to households that experience floods occasionally.

5.2 Conclusion

Based on the analysis of the communities' risk of vulnerability to flooding as well as the perennial household livelihood disruption due to flood experience in the GAMA area, the study concludes that urban Ghana particularly communities along the coastal belt are not immune to flood disasters. Although community location was found to have implications for flood risk and flood experience, the severity and impact of a flood on household livelihood vary characteristically among population subgroups.

The study found a gap regarding community-level adaptation to flood disaster while at household level adaptation was found to be weak. At the household level, individual personal savings were used as mitigation against livelihood disruption during inadequate flood disasters. This implies vulnerability.

Early warning and other weather-related information to the communities could reduce the livelihood disruption among households. This highlights the need to improve climate disaster educational activities and communication to affect all citizens in the GAMA area. Wealth quintile was found to be significant in household livelihood outcomes when flood disaster occurs. It is therefore important for the government to initiate programs to address the urban unemployment situation in those areas to reduce the vulnerability of livelihood disruption. Also, strong institutional collaborations are required to fighting the menace of flooding in the country. The lapses in the institutional approaches to fighting the menace need to be addressed. This analysis pointed to the critical role of education and conscientization of all in addition to strengthening institutional responses to fighting this menace. This highlights the need for a concerted effort toward strengthening mechanisms for addressing flooding and other forms of climate disasters.

Generally, the study contributes to the discourse on household flood experience and highlights the gaps in the community and household adaptations to climate disasters as well as flood impacts on population livelihood. Results from the study could complement existing efforts and strategies by local authorities and institutions to prevent flood impact on household livelihood. It also adds to scholarly researches that try to quantify flood impacts on the community and household livelihood.

5.3 Recommendation

The findings of the study have shed more light on the significant predictors of household livelihood outcomes among residents in selected communities within the Greater Accra Metropolitan Area (GAMA). These findings have implications both for policy and academic research. Against this backdrop, the following recommendations are proposed.

To begin with, the study recommends that residents in flood-prone areas should be provided with public education needed in adopting effective measures that can help reduce their level of vulnerability to prevalent flood occurrences. This can be done through effective and efficient education and training on appropriate measures to adopt in reducing vulnerability to flood disasters among the study population and the nation at large.

Also, the local government should endeavour to liaise with the communities in constructing drainage facilities or distilling already existing drains, and complete projects that are aimed at reducing flood risk in the study area. This requires increasing funding for such projects; therefore, the central government together with other benevolent institutions is encouraged to come on board and support the initiative with funds to enable these projects to be carried out. In this regard, the local authority is urged to be committed, as and when funds are disbursed to aid in this initiative.

In furtherance, the study advocates for the subsidisation of government affordable housing units to enable the urban poor residents in flood-prone areas such as floodplains, to afford decent housing in areas that are not flood-prone. This would help minimize flood disaster cases in the country and would as well enable the government to focus and develop other sectors of the economy.

Moreover, the study also calls for the support and sustained funding for institutions such as NADMO to enable them to continuously provide more relief items to flood victims, as well as to enable NADMO to embark on regular and effective sensitization programme that would help build communities' real resilience to floods. NADMO should as well liaise with other state institutions such as the local government and the national youth authority in organizing campaigns and youth education programme that would help educate more residents especially residents in flood-prone areas on how best they can reduce their level of risk to floods.

Lastly, the government should as a matter of urgency ensure that the proper legislation is been met to help prevent residents from building and residing in flood-prone zones that predispose them to flood experiences. The policies on building permits should be effectively carried out to help ensure that the proper structures are put up and erected at the right and appropriate zones to prevent cases of flood disasters.

References

Abeka, E. A. (2014). Adaptation to urban floods among the poor in the Accra metropolitan area. Doctoral dissertation, University of Ghana.

Adorsu-Djentuh, Y. F. (2018). Implementation of Environmental Sanitation Policies: Assessing the Role of Local Actors in Ghana. The University of Machester (United Kingdom).

Afriyie, K., Ganle, J. K., & Santos, E. (2017). 'The floods came and we lost everything': weather extremes and households' asset vulnerability and adaptation in rural Ghana. Climate and Development, 1-16.

Ahadzie, D. K., & Proverbs, D. G. (2011). Emerging Issues in the Management of Floods in Ghana. International Journal of Safety and Security Engineering, 1(2), 182-192.

Aid, A. (2006). Climate Change and smallholder farmers in Malawi: Understanding poor people's experiences in climate change adaptation.

Alderman, K., Turner, L. R., & Tong, S. (2012). Floods and human health: a systematic review. Environment international, 47, 37-47.

Amoako, C., & Frimpong, E. B. (2015). The three-dimensional causes of flooding in Accra, Ghana. International Journal of Urban Sustainable Development, 7(1), 109-129. doi:10.1080/19463138.2014.98472

Amponsah, P. E. (2004). Seismic activity in Ghana: past, present, and future. . Annals of Geophysics, 47(2-3).

Ansah, S. O., Ahiataku, M. A., Yorke, C. K., Otu-Larbi, F., Yahaya, B., Lamptey, P. N., & Tanu, M. (2020). Analysis of Floods in Ghana. Advances in Meteorology.

Antwi-Agyei, P., Dougill, A. J., Fraser, E. D., & Stringer, L. C. (2013). Characterizing the nature of household vulnerability to climate variability: empirical evidence from two regions of. . Environment, development and sustainability, 903-926. Retrieved October 17, 2014

Antwi-Agyei, P., Stringer, L. C., & Dougill, A. J. (2014). Livelihood adaptations to climate variability: insights from farming households in Ghana. Regional environmental change, 14(4), 1615-1626.

Appeaning-Addo, K. (2011). Impacts of coastal inundation due to climate change in a cluster of urban coastal communities in Ghana, West Africa. Remote Sensing, 3, 2029-2050. doi:10.3390/rs3092029

Appeaning-Addo, K. A., & Adeyemi, M. (2013). Assessing the impact of sea-level rise on a vulnerable coastal community in Accra, Ghana: Original research. Jamba: Journal of Disaster Risk Studies, 5(1), 1-8.

Armah, F. A., Yawson, D. O., Yengoh, G. T., Odoi, J. O., & Afrifa, E. K. (2010). Impact of floods on livelihoods and vulnerability of natural resource-dependent communities in Northern Ghana. Water, 2(2), 120-139.

Assembly, A. M., & Habitat, U. N. (2011). Participatory slum upgrading and prevention millennium city of Accra, Ghana.

Asumadu-Sarkodie, S., Owusu, A. P., & Rufangura, P. (2015). Impact analysis of flood in Accra, Ghana. Advances in Applied Science Research, 6(9), 53-78.

Awumbila, M., Owusu, G., & Teye, J. K. (2014). Can rural-urban migration into slums reduce poverty? Evidence from Ghana. Migrating Out of Poverty Working Paper, 13, 1-14.

Baffoe-Bonnie, B. Y., FA, B. S., Ofori, A., & Collins, A. (2006). Human Health Vulnerability and Public Health Adaptation to Climate Change: Risks and Responses Assessment Report. Government of Ghana Environment Protection Agency Netherlands Climate Assistance Programme (NCAP).

Barret, C. B., Barnett, J. B., Carter, M. R., Chantarat, S. H., JW, M., DE, S., . . . Ward, M. (2007). Poverty traps and climate risk: limitations and opportunities of index-based risk financing. International Research Institute for Climate and Society Technical Report, 7(2).

Bonsu, P. (2020). The Impact and Development of handling PET bottles waste: Case Kasapreko Ltd in Ghana.

Braimah, M. M., Abdul-Rahaman, I., Oppong-Sekyere, D., Momori, P. H., Abdul-Mohammed, A., & Dordah, G. A. (2014). A Study into the Causes of Floods and its Socio-economic Effects on the People of Sawaba in the Bolgatanga Municipality, Upper East, Ghana. International Journal of Pure & Applied Bioscience.

Braun, B., & Abheuer, T. (2011). Floods in megacity environments: vulnerability and coping strategies of slum dwellers in Dhaka/Bangladesh. Natural hazards, 58(2), 771-787.

Bulkeley, H., Schroeder, H., Janda, K., Zhao, J., Armstrong, A., Chu, S. Y., & Ghosh, S. (2009). Cities and climate change: the role of institutions, governance, and urban planning. Change, 28-30.

Bull-Kamanga, L. D., Lavell, K., Leon, A., Lerise, E., Macgregor, F., Maskey, H., . . . Yitambe, A. (2003). From Everyday Hazards To Disasters: The Accumulation Of Risk In Urban Areas. Environment And Urbanization, 15(1).

Carney, D. (1998). Sustainable Livelihoods. What difference can we make? Department for International Development's Natural Resources Advisors Conference. London.

Chambers, R., & Conway, G. (1992). Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies.

Confalonieri, U., Menne , B., Akhtar, R., Ebi, K. L., Hauengue, M., Kovats, R. S., & Woodward , A. (2007). Human health. climate change 2007: impacts, adaptation, and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Coppola, D. P. (2007). Introduction to International Disaster Management.

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., & Patterson, C. (2009). Managing the health effects of climate change. Lancet, 1693-1733.

Department for International Development. (1999). Sustainable livelihoods guidance sheets. Retrieved from http://www.ennonline. net/pool/files/ife/dfid-sustainable-livelihoods-guidance-sheet-section1.pdf

Department for International Development. (2000). Sustainable livelihoods guidance sheet. Retrieved October 11, 2016, from http://www.ennonline.net/dfidsustainableliving

Department for International Development, U.K. (1999). Sustainable livelihoods guidance sheets.

DFID, U.K. (1999). Sustainable livelihoods guidance sheets.

Dodman, D. I. (2012). Cities and climate change initiative, tool series, developing local climate change plans, a guide for cities in developing countries.

Doocy, S., Daniels, A., Murray, S., & Kirsch, T. D. (2013). The human impact of floods: a historical review of events 1980-2009 and systematic literature review. PLoS currents, 5.

Ellis, F. (2000). Rural livelihoods and diversity in developing countries. Oxford university press.

Em-dat, C. R. (2010). The OFDA/CRED international disaster database. Université catholique.

Environmental Protection Agency. (2011). Understanding the Risks, Empowering Communities, Building Resilience.

Environmental Protection Agency. (2012). . Flood and Drought Risk Mapping in Ghana.

Foresight OST. (2013). Future Flooding. Retrieved May 26, 2013, from http://www.foresight.gov.up/Previous_Projects/Flood_and_Coastal_Defence

Garbero, A., & Muttarak, R. (2013). Impacts of the 2010 droughts and floods on community welfare in rural Thailand: differential effects of village educational attainment. Ecology and Society, 18(4).

Garcia de Leaniz, C., Fleming, I. A., Einum, S., Verspoor, E., Jordan, W. C., Consuegra, S., & Webb, J. H. (n.d.).). A critical review of adaptive genetic variation in Atlantic salmon: implications for conservation. Biological Reviews, 82(2), 173-211.

Ghana Statistical Service. (2012). 2010 Population and Housing Census: Summary Report of Final Results.

Ghanaweb.com. (5015). Flood disaster profile of Ghana since 1968. Retrieved June 5, 2015, from http://www.ghanaweb.com/GhanaHomePage/NewsArchive/artikel.php?ID=361061

Guha-Sapir, D., & Ph, H. (2015). The numbers and trends. Annual disaster statistical review 2014.

Guha-Sapir, D., Below, R., & Hoyois, P. (2016). EM-DAT: The CRED/OFDA international disaster database.

Gyau-Boakye, P. (1997). Flood Control Measures: Hazard Mapping, Water Research Institute of Centre for Scientific and Industrial Research (CSIR), Accra, Ghana.

Hallegatte, S., & Erman, A. (2018). Resilience is more than income lessons from Accra's 2015 floods. Retrieved from http://www.blogs.worldbank.org

Hansen, J., Sato, M., Hearty, P., Ruedy, R., Kelley, M., Masson-Delmotte, V., & Velicogna, L. (2016). Ice Melt, Sea Level Rise, and Superstorms. doi:1602.01393

Hartmann, Thomas, & Tejo Spit. (2016). Implementing the European Flood Risk Management Plan. Journal of Environmental Planning and Management, 59(2), 360-377. doi:10.1080/09640568.2015.1012581.

IFRC Ghana. (2018). Floods Emergency Plan of Action (EPA) Final Report Operation no. MDRGH014.

Institute of Local Government Studies and International Water Management Institute. (2012). Community adaptation to flooding risk and vulnerability.

International Federation of Red Cross. (2017). Annual Report.

International Labor Organization (ILO). (2006). The Reader: Implementing sustainable private sector development: Striving for tangible results for the poor. Int. Training Centre of ILO, 66. Retrieved from http://www.bdsknowledge.org/dyn/ bds/docs/497/PSDReader 2006. pdf

Jabeen, H., Johnson, C., & Allen, A. (2010). Built-in resilience: learning from grassroots coping strategies for climate variability. Environment and Urbanization, 22(2), 415-431.

Jha, A. K., Bloch, R., & Lamond, J. (2012). Cities and flooding: a guide to integrated urban flood risk management for the 21st century. The World Bank.

Jha, R., & Gaiha, R. (2012). NREGS: Interpreting the official statistics. Economic and Political Weekly, 47(40), 18-22.

Karley, N. K. (2009). Flooding and physical planning in urban areas in West Africa: a situational analysis of Accra, Ghana. Theoretical and Empirical Researches in Urban Management, 4(13), 25-41. Retrieved from http://um.ase.ro/No13/2.pdf accessed on12/03/2017

Kithiia, J. (2011). Climate change risk responses in East African cities: need, barriers, and opportunities. Current opinion in environmental sustainability, 3(3), 176-180.

Koks, E. E., Jongman, B., Husby, T. G., & Botzen, W. J. (2015). Combining hazard, exposure, and social vulnerability to provide lessons for flood risk management. Environmental science & policy, 47, 42-52.

Kundzewicz, Z. W., Kanae, S., Seneviratne, S. I., Handmer, J., Nicholls, N., Peduzzi, P., & Muir-Wood, R. (2014). Flood risk and climate change: global and regional perspectives. Hydrological Sciences Journal, 59(1), 1-28.

Kusi-Appiah, F. (2016). Power market structure: competition law enforcement and electricity security.

Kusi-Appiah, T. (2017). Urban flood risk management: a case study of Aboabo, Kumasi. Diss.

Meyers, L. A., & Bull, J. J. (2002). Fighting change with change: adaptive variation in an uncertain world. Trends in Ecology & Evolution, 17, 551-557.

Morris, J., Penning-Rowsell, E., & Chatterton, J. (2010). The costs of the summer 2007 floods in England. . Joint.

Morse, S., & McNamara, N. (2013). The Theory Behind the Sustainable Livelihood Approach. In Sustainable Livelihood Approach, 15-60.

Mulungeta, G., Ayngli, S., Daby, O. P., Gudyanga, F., Lucio, F., & Durrheem, R. (2007). Natural and Human-Induced Hazards Disasters in Sub-Saharan Africa Science Plan.

Mumuni, A. (2013). Flooding and Diarrhoeal Disease Incidence in Urban Poor Communities in Accra, Ghana. Investigating the Effects of Risk Perception Measures. Retrieved from http://197.255.68.203/handle/123456789/5451.

Munich, R. (2002). analysis of natural catastrophes.

Munich-Re. (1997). Flooding and Insurance. Municher Ruckversicherungs-Gesellshaft.

National Disaster Management Organization. (2014). Challenges And Strategies For Rapid Response In Disaster Relief Operations In Ghana.

National Disaster Management Organization (NADMO). (2009). Summary of Disaster. Retrieved from http://www.nadmo.gov.gh

Natural Resources Defense Council. (2012). Sustainability Report.

Nyarko, B. K. (2002). Application of a rational model in GIS for flood risk assessment in Accra, Ghana. Journal of Spatial Hydrology, 2(1).

Okyere , C. Y., Yacouba, Y., & Gilgenbach, D. (2013). The problem of annual occurrences of floods in Accra: An integration of hydrological, economic and political perspectives. Theoretical and Empirical Researches in Urban Management, 8(2), 45-79.

Oppong, B. K. (2011). Environmental hazards in Ghanaian cities: the incidence of annual floods along the Aboabo river in the Kumasi Metropolitan Area (KMA) of the Ashanti Region of Ghana. Kumasi, Ghana. Kwame Nkrumah University of Science and Technology, Department of Geography and Rural Development.

Ouma, Y. O., & Tateishi, R. (2014). Urban flood vulnerability and risk mapping using integrated multi-parametric AHP and GIS: methodological overview and case study assessment. Water, 6(6), 1515-1545.

Owusu, A. B., & Agbozo, M. (2019). Application of Geographic Information Systems for Flood Risk Analysis: A Case Study from Accra Metropolitan Area. Present Environment and Sustainable Development, 13(1), 81-97.

Pachauri, R. K., Allen, M. R., Barros, V. R., Broome, J., Cramer, W., Christ, R., & Dubash, N. K. (2014). Climate change 2014: synthesis report. Contribution of Working Groups I. II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change, 151.

Peprah, C., Amponash, O., & Oduro, C. (2019). A system view of smart mobility and its implications for Ghanaian cities. Sustainable Cities and Society, 739-747.

PreventionWeb. (2012). Ghana – Disaster Statistics, Geneva, Switzerland. Retrieved from http://www.preventionweb.net/English/countries/statistics/?cid=67.

Rain, D., Engstrom, R., Ludlow, C., & Antos, S. (2011). Accra Ghana: A city vulnerable to flooding and drought-induced migration: A case study prepared for cities and climate change. Global Report on Human Settlements, 2. Retrieved December 1, 2013, from http://www.unhabitat.org/grhs/2011

Rakodi, C. (2014). Urban livelihoods: A people-centered approach to reducing poverty.

Renn, O., Burns, W. J., Kasperson, J. X., Kasperson, R. E., & Slovic, P. (1992). The social amplification of risk: Theoretical foundations and empirical applications. Journal of social issues, 48(4), 137-160.

Rufat, S., Tate, E., Burton, C. G., & Maroof, A. S. (2015). Social vulnerability to floods: Review of case studies and implications for measurement. International Journal of Disaster Risk Reduction, 14, 470-486.

SAARC. (2012). Workshop on flood risk management in south Asia. Retrieved April 2020, from https://www.coursehero.com/file/24354712/SAARC-workshop-on-Flood-2012pdf/Integrated flood management tools series flood forecasting and early warning

Sam Jr, P. A. (2009). Flooding in Accra Research report. Modern Ghana. Retrieved January 19, 2015, from http://www.modernghana.com/news/223780/1/floodinginaccra-research-report.html

Sayers, Paul, Yuanyuan, L., Galloway, G., Penning-Rowsell, E., Fuxin, S., . . . Quesne, T. L. (2013). Flood Risk Management: A Strategic Approach. Paris, France. UNESCO. Retrieved from http://unesdoc.unesco. org/images/0022/002208/220870e.pdf.

Serrat, O. (2017). The sustainable livelihoods approach. Knowledge solutions, 21-26.

Sharif, H. O., Hossain, M. M., Jackson, T., & Bin-Shafique, S. (2012). Person-place-time analysis of vehicle fatalities caused by flash floods in Texas. Geomatics, Natural Hazards, and Risk, 3(4), 311-323.

Siegel, R., DeSantis, C., Virgo, K., Stein, K., Mariotto, A., Smith, T., & Lin, C. (2012). Cancer treatment and survivorship statistics, 2012. CA: a cancer journal for clinicians, 62(4), 220-241.

Smith, K. (2004). Environmental Hazards: Assessing Risk and Reducing Disaster.

Songsore, J. (2011). Regional Development in Ghana: the Theory and the Reality (New Edition).

Songsore, J., Nabila, J. S., Yangyouro, Y., Avles, S., Hamilton, E. K., Amponsah, P. E., & Alhassan, O. (2009). Integrated disaster risk and environmental health monitoring in the Greater Accra Metropolitan Area. (M. Pelling, & B. Wisner, Eds.) Disaster risk reduction: Cases from urban Africa.

Takagi, H., Esteban, M., Mikami, T., & Fujii, D. (2016). Projection of coastal floods in 2050 Jakarta. Urban Climate, 17, 135-145.

Tall, A., Mason, S. J., Van Aalst, M., Suarez, P., Ait-Chellouche, Y., Diallo, A. A., & Braman, L. (2012). Using seasonal climate forecasts to guide disaster management: The Red Cross experience during the 2008 West Africa floods. International Journal of Geophysics.

Tao, T. C., Wall, G., & Wismer, S. (2010). Culture and sustainable livelihoods. Journal of Human Ecology, 29(1), 1-21.

Tarkanyi, F. (2012). Progress Report, Nuclear Reaction Data Group at ATOMKI (No. INDC (NDS)--0618).

Tengan , C., & Aigbavboa, C. O. (2016). Addressing flood challenges in Ghana: a case of Accra metropolis. Johannesburg, South Africa, 10,12.

Thaler, T., & Hartmann, T. (2016). Justice and flood risk management: reflecting on different approaches to distribute and allocate flood risk management in Europe. Natural Hazards, 83(1), 129-147.

Thilagaraj, A. (2016). An overview of flood management. ZENITH International. International Journal of Multidisciplinary Research, 6(1), 294-301.

Thomas, J. J., Prakash, B., Kulkarni, P., & Murthy, M. R. (2019). Int. J. Community Med. Public Health (Gujarat), 6(3), 1143-1146.

Tschakert, T., Sagoe, R., Ofori-Darko, G., & Codjoe, N. S. (2010). Floods in the Sahel: an analysis of anomalies, memory, and anticipatory learning. Climate Change. doi:10.1007/s10584-009-9776-y

UN/ISDR. (2004). Living with risk. A global review of disaster reduction initiatives, 1.

UN-Habitat. (2011). Cities and Climate Change. Global Report on Human Settlements 2011.

United Nations Development Programme (UNDP). (2009). Adaptation definitions and levels. Retrieved 07 August 2012, from www.undp.org/climatechange/adapt/definitions.html.

United Nations Human Settlements Program (UN-Habitat). (2008). State of the world‟s cities: 2008/2009: Harmonious cities.

United Nations Office for Disaster Risk Reduction. (2011). Global Assessment Report on Disaster Risk Reduction.

World Bank. (2008). Climate-resilient cities: 2008 Primer Reducing Vulnerabilities to Climate Change Impacts and Strengthening Disaster Risk Management in East Asian Cities.

World Bank Group. (2016). World development report 2016: digital dividends. World Bank Publications.

Zhang, W., Villarini, G., Vecchi, G. A., & Smith, J. A. (2018). Urbanization exacerbated the rainfall and flooding caused by hurricane Harvey in Houston. Nature, 563(7731), 384-388.