



Assessing the Vulnerability and Coping Mechanisms of Shiashie, East Legon and Agbogbloshie Communities in Accra-Ghana to the Impacts of Floods

A Research Paper presented by:

Ivy Frimpomaa Asiedu
(Ghana)

in partial fulfilment of the requirements for obtaining the degree of
MASTER OF ARTS IN DEVELOPMENT STUDIES

Major:

Agrarian, Food, and Environmental Study
(AFES)

Members of the Examining Committee:

Luisa Cortesi
Murat Arsel

The Hague, The Netherlands
December 2024

Disclaimer:

This document represents part of the author's study programme while at the International Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

Inquiries:

International Institute of Social Studies
P.O. Box 29776
2502 LT The Hague
The Netherlands

t: +31 70 426 0460
e: info@iss.nl
w: www.iss.nl
fb: <http://www.facebook.com/iss.nl>
twitter: [@issnl](https://twitter.com/issnl)

Location:

Kortenaerkade 12
2518 AX The Hague
The Netherlands

Contents

<i>List of Figures</i>	<i>v</i>
<i>List of Maps</i>	<i>v</i>
<i>List of Acronyms</i>	<i>vi</i>
<i>Abstract</i>	<i>vii</i>
Chapter 1 Introduction	1
1.1 Background of the Research Topic	1
1.2 Problem Statement	3
1.3 Context of the Study	3
1.4 Case Studies	5
1.5 Research Gaps	7
1.6 Research Questions	7
1.7 Justification and Significance of the Study	8
Chapter 2 Literature Review	9
2.1 Contextualizing Vulnerability	9
2.1.1 Defining vulnerability in the context of flooding	9
2.1.2 The Concept of Vulnerability	9
2.1.3 Political Ecology of Vulnerability Assessment	10
2.2 Influence of Risk Perception on Vulnerability	11
2.3 Coping strategies for floods	12
2.3.1 Defining Coping Strategies	12
2.3.2 Coping Mechanisms, Resilience and Relationship with Vulnerability	12
2.3.3 Factors Influencing Coping Strategies and Perception of Vulnerability	13
2.3 Social Vulnerability Theory	14
2.4 Conceptual Framework	14
Chapter 3 Methodology	16
4.1 Introduction	16
4.2 Research Approach	16
4.3 Research Design	16
4.4 Sampling and Participants	17
4.5 Data Collection	17
4.6 Data Analysis	17
4.7 Ethical Considerations	18
Chapter 4 Findings and Discussion	19
5.1 Demographic Data	19
5.2 Socioeconomic Factors Contributing to Vulnerability	19
5.2.1 Income and Employment	19
5.2.2 Education and Technology Use	20

5.2.3 Social and Communal Support	21
5.3 Risk Assessment	22
5.3.1 Perception of Flood Risk and Contributing Factors	22
5.3.2 Perceived Damages	23
5.3.3 Perceived Risk Based on Exposure	24
5.4 Coping Mechanisms and Resilience	24
5.4.1 Coping Measures and Strategies	24
5.4.3 Building Flood Resilience	25
5.4.4 Influence of Community and Social Networks	26
5.5 Role of Institutional Factors and Governmental Support	26
5.6 Theoretical Implications	28
5.7 Practical Implications	29
Chapter 5 Conclusion	31
References	33

List of Figures

Figure 1: Socio-economic factors' Influence on Flood Vulnerability	15
--	----

List of Maps

Map 1: A map of Accra Metropolis; source researchgate.net	4
Map 2: <i>Shiashie, East Legon study area</i>	6
Map 3: <i>Agbogbloshie study area</i>	7

List of Acronyms

AMA	Accra Metropolitan Assembly
NADMO	National Disaster Management Organization
PAR Model	Pressure and Release Model
RH	Risk Hazard

Abstract

This study focuses on flooding which is a persistent problem that affects inhabitants of Accra in Ghana with adverse consequences on their socioeconomic activities and the development of the city. The main objective is to identify whether there is a difference in vulnerability outcomes due to socioeconomic differences between populations affected by the impacts of flooding. This is important because of vulnerability differences can influence policy outcomes in terms of developing interventions to address vulnerable population during flooding events. The objective is addressed through a cross-sectional study using semi-structured interviews on residents in Shiashie, East Legon and Agbogbloshie who are vulnerable to rain-induced flooding. The main findings are factors such as income, education, and technology use influence vulnerability differences between Shiashie, East Legon and Agbogbloshie. Residents with higher income are better equipped to prepare and recover from the impacts of flooding while those with higher educational levels are more likely to utilize technology more effectively to keep track and understand flood warnings. Social and communal support improved resilience though there was no clear pattern between the two regions. Communities experienced different risk perceptions and pressures as influenced by unsafe conditions in their environment. Human activities such as dumping and disposal of waste would create unsafe conditions such as clogging of drains especially for residents in Agbogbloshie leading to increased vulnerability. Recommendations include local and state governments implementing policies that factor socioeconomic disadvantages to help reduce vulnerability outcomes and promote resilience when faced the adverse impacts of flood events in Accra. Future studies can seek to use a longitudinal approach to get a clearer assessment of how socioeconomic factors influence vulnerabilities and coping strategies before, during, and after flooding events.

Keywords

Vulnerability; Coping Mechanisms; Flooding.

Chapter 1 Introduction

1.1 Background of the Research Topic

Seventeen years ago, I clearly recall the apprehension that enveloped our household whenever ominous clouds formed in the sky. My mother would swiftly relocate our possessions on elevated shelves, in an attempt to safeguard them from the water seeping into our house. Frequently, she would place my brother and I onto a table to avoid our feet touching the water. Some days were particularly tense when my parents were at work and my brother, and I were at school. The uncertainty greatly caused anxiety. Upon returning home, we frequently encountered the distressing scene of furniture saturated with water and other household things damaged. The continuous pattern of predicting floods, managing the consequences, and the resulting sense of helplessness created an environment of constant stress and unhappiness. These experiences have significantly influenced my perspective on the importance of efficient flood control and good infrastructure. The paper emphasizes the immediate necessity for improved urban planning and disaster preparedness, particularly in neighborhoods that are at high risk. Reflecting on those past experiences, I am inspired to actively participate in the development of effective remedies that can prevent others from experiencing similar adversities.

Flooding is a persistent serious problem that has a significant impact on urban areas across the globe (Jha et al., 2011). Climate change remains one of the main causes of extreme flooding in recent years. The risks of flooding have increased with changes in the climate and global warming leading to changes in weather patterns and intensity of rainfall in different parts which is a precursor to flooding (Arnell & Lloyd-Hughes 2014; Lan et al. 2024). The changes in temperature, storms and rainfall patterns means floods are becoming more frequent and larger in different places globally (O'Shea et al. 2024). As a result, 1.81 billion people worldwide are at a risk of flooding (Rentschler, Salhab & Jafino, 2022). The frequency and impact of these floods is disproportionately concentrated in middle and low-income countries and regions such that 89% of people exposed to flooding risks, live in these countries. Data from Rentschler, Salhab & Jafino (2022) shows sub-Saharan Africa accounts for 44% of people facing poverty and flooding risks. In Africa, Africa Climate Mobility Initiative (2024) indicates that in the period 2000 to 2020, flooding constituted 80 per cent of all-disasters. Annually, an average of 40 major flood events occurs in Africa (Relief Web International, 2022). Some of the significant flooding events have occurred in West Africa which typically experiences heavy rainfall (Nka et al. 2015). One of the West African nations significantly affected by floods is Ghana.

Geographical factors and environmental factors are also crucial risk factors in flooding. As such, regions in monsoon climate zones and those experiencing common tropical storms such as Mozambique are prone to flooding (Benito, Aerts, Eilander, Ward & Muis, 2024). Additionally, the topography of an area is crucial because low lying areas close of coastlines and river bodies are susceptible to flooding (Brempong et al. 2023). Causes of floods such as tropical cyclones, tsunamis, hurricanes, intense rainfalls and storm surges have also been associated with higher flooding risks (Merz, 2021). Floods are solely not just rain induced but various factors contribute to its occurrence. Some of these include river overflows, rising sea levels, poor drainage systems, improper waste management, and the destruction or overflow of dams (Karley, 2009; Sanyal & Lu, 2005). Accra is situated along the coast of the Gulf of Guinea and is intersected by rivers flowing through the city, potentially increasing its susceptibility to flooding. Although these conditions create the potential for flooding, it only

becomes a disaster when it causes harm, destroys properties, displaced people, and damages infrastructure.

Infrastructure development and urbanization as important risk factors to flooding in many areas across the globe, including West Africa. This trend of urbanization decreases the areas available for percolation leading to poor absorption of water and increased surface runoff (Daksiya, Mandapaka & Lo, 2021; Karley, 2009). Infrastructure development in these urban centers in West African nations is poorly planned and leads to building roads, building and other physical developments in flood prone areas. Riparian zones in Ghana are commonly developed leading thus overwhelming the natural waterways and reducing the hydrologic response-time that could potentially reduce flood risks (Abass et al. 2020). In regions such as Ghana, the high rate of urbanization has been notably linked to increased rates of flooding and higher susceptibility of cities such as Accra to flooding risk (Abass et al. 2022).

The floods result into devastating consequences for the city's infrastructure and inhabitants. Spillages from Weija Dam and Bagre Dam have also been important risks to spillage-induced flooding in Accra especially after long rains in the region (Asare & Tuffour, 2024). Inadequate drainage infrastructure and poor maintenance of drainage have contributed to flooding in Accra. Amoako & Frimpong Boamah (2015) also identifies poor drainage design as a contributing to a high frequency of floods in Accra. Due to these risk factors, urban flooding has been a major problem in Accra since the early 1930's (Karley 2009). Also, according to (Twumasi & Asomani Boateng 2002; Karley 2009; Rain et al. 2011 as cited in Amoako and Frimpong Boamah, 2014) significant flood disasters having been recorded in 1955, 1960, 1963, 1973, 1986, 1991, 1995, 1999, 2001, 2002, 2010 and 2011. These trends indicate the high frequency of flooding in Accra and its environs.

The actual impacts of floods come from the damage it leaves behind, rather than just the excess of water. The floods often result in the loss of life, damage to property and infrastructure, displacement of people, economic impact and even environmental damage. During these floods, loss of life and injuries are commonplace. In the aftermath of flooding the news on television and social media depicts harrowing scenes of people attempting to swim through the floodwaters to reach their homes. Some individuals seeking shelter, with a significant number gathering at a nearby fuel station to take refuge from the rain. Tragically, in 2015, there was a fuel leak from the Goil filling station at the Kwame Nkrumah Interchange, which mixed with the floodwaters and led to an explosion. This event that occurred on 3rd of June and claimed 154 lives, it was a profoundly tragic episode in Ghana's history, often referred to as the 'Twin Disaster' (Cobbinah & Poku-Boansi, 2018). Floods frequently lead to the destruction of businesses and the unemployment of individuals living in Accra, particularly those living in informal areas including as street vending, small-scale retail, and agricultural, experience significant decreases in their income when floods cause damage to their income when floods cause damage to their workplaces and goods. According to Amoako & Inkoom (2017), the flooding of markets and commercial areas leads to temporary closures, resulting in income lost for traders and employees. Many people are usually unable to reach their workplaces, leading to a temporary standstill of daily activities in the city.

Flooding of urban areas in Accra, Ghana, is a major problem that has adverse impacts on the socio-economic activities of the inhabitants and the development of the city. There have been several interventionist strategies employed by the authorities and communities to try and reduce the occurrence of floods but floods are on the increase and this is due to some reasons like urbanization, poor infrastructure, effects of climatic change and some other factors. Besides, the households earning low-income struggle with the effects of floods and have poor coping and preparedness to floods. Considering the skewed nature of climate change effects with regards to socio-economic classes, Arsel (2023) noted that the poor are the worst affected persons and they have played no role in contributing to the climate change that is

now a global menace. The interplay between climate change and class therefore calls for a further understanding on how environmental factors, governance structures and socio-economic factors play out in the susceptibility to flood impacts and coping mechanisms of different communities of different socio-economic classes.

1.2 Problem Statement

Flooding is a critical concern in Accra, Ghana due to its devastating effects on people living in the region. A key issue related to flooding in the region is related to the disproportionate impacts of floodings on the population. Response solutions such as policies and initiatives have encountered limited efficacy because they do not holistically address all the sources of vulnerability. A number of solutions have been suggested to address issues such as poor infrastructure though few have gone ahead to consider challenges faced by the local population. In particular, they do not adequately address socio-economic factors influencing vulnerabilities among different groups in Accra. Gaisie & Cobbinah (2023) argue that any such intervention measures have not based on the comprehension of local coping mechanisms to floods. The authors mention that, while local knowledge is important in the anticipation and preparation of floods its integration in national policy frameworks limits its potential for improving response to flooding. Similarly, the studies of Aboagye (2012) and Codjoe et al. (2014) on floods in Accra identify inadequate recognition and integration of local knowledge as one of the major implementation gaps in implementation of flood interventions. Therefore, this study proposes that there is a need to understand how socioeconomic factors as one of local population dynamics influence vulnerability to flooding events in the regions as a departure from the extensive investigation into the physical and environmental effects of flooding. This is because different communities are likely to be differently impacted by flooding based on their socio-economic circumstances, location, adaptive capacity and perception of risk hence there cannot be a one-fits all solutions to flooding. Exploring factors such as income levels and access to resources is likely to provide critical insights into how community prepare, respond and recover from the impacts of flooding. This can include understanding whether marginalized populations and economically disadvantaged communities in the Accra are disproportionately affected by the impacts of flooding which can help in the identification of interventions that can be used to reduce vulnerability and improve coping capacity. Therefore, this research aims to critically assess socioeconomic factors influencing the vulnerability to impact of floods and coping mechanism of Shiashie, East Legon and Agbogbloshie. The goal is to provide actionable insights and recommendations for enhancing flood resilience in Accra.

1.3 Context of the Study

The study will be conducted in Accra, the capital city of Ghana, with an area of 185km². This area serves as a key location to conduct this research because it is a rapidly growing urban center. The Accra Metropolitan District is one of the 254 administrative divisions in Ghana, situated in the Greater Accra Region. As of 2021, the population of Greater Accra had a population of 284,124 in 2021. Accra is characterized by a diverse population with marked socio-economic disparities, and its geographical location along the coast and near some rivers makes it particularly vulnerable to rain-induced flooding. Atakorah et al. (2023) found in their study that geophysical conditions of Accra make over 70% of the region more susceptible to annual flooding. These conditions include land cover, flow accumulation, rainfall, elevation, slope and soils.



Map 1: A map of Accra Metropolis; source researchgate.net

Several factors have been identified to enhance vulnerability of Accra to rain-induced floods. According to Amoako & Frimpong Boamah (2014) the causes of flooding in the city include rapid growth of urbanization, poor urban planning, and poor or inadequate drainage facilities. Due to urbanization, floodplains and wetlands have been encroached especially in areas like Agbogbloshie, and this has decreased their natural ability to store water and hence the quantity of water flowing over the land surface. The city's inadequate waste disposal hampers the situation and results in clogged drainages and water ways (Amato et al. 2019). Climate change has been identified to be one of the major factors which has enhanced the frequency and intensity of flood disasters in Accra. Climate change produces extreme weather conditions and unexpected and frequent floods (Douglas et al. 2008). All these factors lead to the development of a very challenging environment for flood management in Accra. The vulnerability of residents of Accra to urban flooding due to socio-economic factors has been well described. In their contribution to this debate, Bankoff, Frerks and Hilhorst (2004) define vulnerability as the combination of physical location and social, economic and political status that affects an individual's ability to respond and recover from disasters.

People living in the informal sector especially in the urban area of Accra are vulnerable due to the fact that they have minimal access to resources and services. Amoako & Inkoom (2017) discusses the effects of informal urbanization on flood hazards whereby such groups are exposed to floods since they settle in flood prone areas with poor infrastructure. The study by Rain et al. (2011) concentrates on Accra and the relationship made between poverty and vulnerability of flood in urban areas. They posit that vulnerable groups such as those from low-income urban population are likely to reside in flood prone regions and are also likely to have limited capacity to move to other safer grounds whenever floods recur. These, coupled with lack of effective government support and systems to respond to disasters, makes them even more vulnerable. People of different classes in the society have different ways through which they deal with flood in urban areas. Sanyal & Lu (2005) stresses that the community plays a critical role in the deployment of adaptive measures like building of barriers and upgrade of local drainage. However, these methods can be ineffective when applied to handling of floods of high magnitude. The paper supports Twigg's (2015) position that local knowledge should be incorporated into state-driven disaster risk reduction in order to

improve resilience. The local government can put in place several ways of dealing with the floods such as enhancing the infrastructure and public education. However, as cited by Jha et al. (2011), such efforts are often faced by challenges like poor funding, poor management, and poor coordination that are evident between different government departments. Therefore, to reduce the risks of disasters a comprehensive plan that include the physical and social economic factors associated with vulnerability to flood impacts should be put in place.

In an article by Karley (2009) a comprehensive description of the deficiencies in urban planning and physical infrastructure in the city which has been historically reactive to responding too flood risks. Although there are zoning and construction laws, poor enforcement has resulted in the situation exacerbating which highlights gaps in the policy implementation in the region. Moreover, the city has been described as facing other challenges such as drainage systems being in a poor state making them less effective in handling large amounts of water especially during heavy rainfall. This has led to studies such as that by Amoako & Frimpong Boamah (2014) stating that there is the need to ensure that comprehensive improvements are made to the drainage system through construction of new ones as well as ensuring proper maintenance of the existing ones. Also, the implementation of green infrastructure systems for example, permeable pavements, swales, and wetlands in the urban areas could thus help enhance capacity and raise the standard of flood resilience of the city. Douglas (2008) suggests that one way of improving the flood risk management in Accra is through the adoption of sustainable and context-appropriate measures including urban planning and strong infrastructure for effective flood management. Nevertheless, most of these proposals are aimed at infrastructure issues and do not tackle vulnerability challenges that local communities continue to encounter during flooding events.

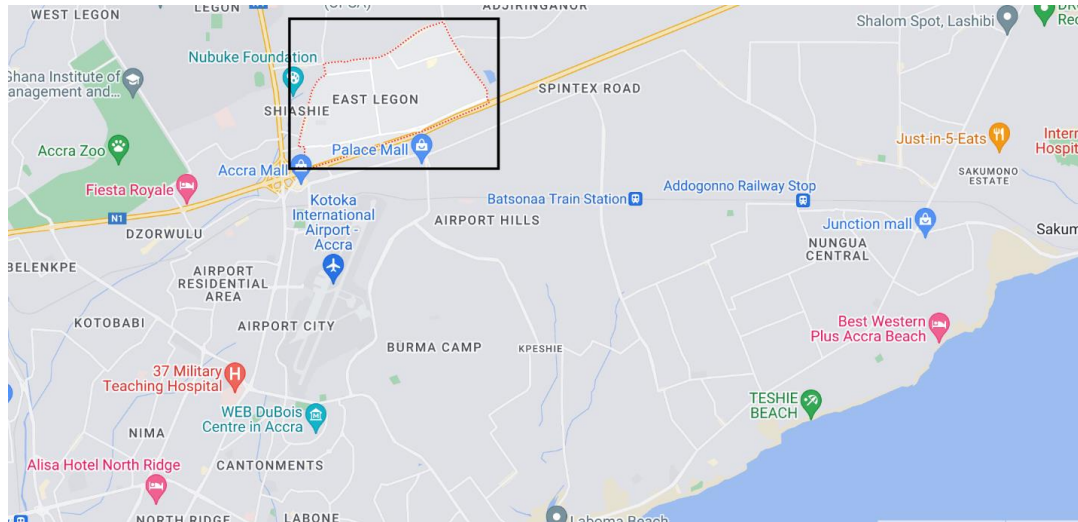
1.4 Case Studies

Flooding in Accra not only affects informal settlements but also other forms of urban settlements including suburbs. The article of Atakorah et al. (2023) on “Geophysical assessment of flood vulnerability of Accra” concludes that areas with average and high incomes regions of Accra are becoming increasingly vulnerable to impacts of flooding. In the research by Atakorah et al. (2023) vulnerability implies the level of proneness of the infrastructure or an area to flooding. For this research, vulnerability refers to the level of harm that is expected from exposure to flooding. For my research study, I choose two case studies with different socio-economic profiles: Shiashie, East Legon and Agbogbloshie.

Shiashie, East Legon

Shiashie, East Legon has a total distance of 9.36 kilometers and covers an area of 4.92 square kilometers. The terrain in the area is flat similar to the Accra plains. Based on flood modeling by Dekongmen et al. (2021), these plains in Accra have made this Accra metropolis prone to rain-induced urban flooding. The region is a middle-class commercial zone in Accra Metropolitan district. It has a growing population of Shiashie, East Legon middle- and upper-income earners who are homeowners (Avordeh et al., 2023). The housing in of Shiashie, East Legon consists of gated communities and modern apartments. In the Shiashie, East Legon is a commercial center with many businesses including small scale businesses, large shopping malls, restaurants, cafes and banks. The area is significantly urbanized with institutional, commercial and residential infrastructure being prominent in the region. The area has drainage infrastructure featuring man-made and natural channels. The drainage channels and small streams flow towards Korle Lagoon. But despite these channels being available, a study by Nyarko (2014) showed high flood risk zones covered 35.66% of Accra while low risk covers 26.85%; this study shows the case study region of Shiashie, East Legon is also prone to flooding despite drainage channels being available. Furthermore, Møller-Jensen, Agergaard,

Andreasen, Oteng-Ababio & Yankson (2020) report that the natural vegetative cover in the area has been replaced by urban development and infrastructure such as roads. This unregulated urban expansion in the area has been linked with higher flood risks in Shiashe, East Legon (Andreasen, Agergaard, Allotey, Møller-Jensen & Oteng-Ababio 2023). In relation to climate, the region experiences two rain seasons with the main one is lasting from April-July and the minor one from September to November.

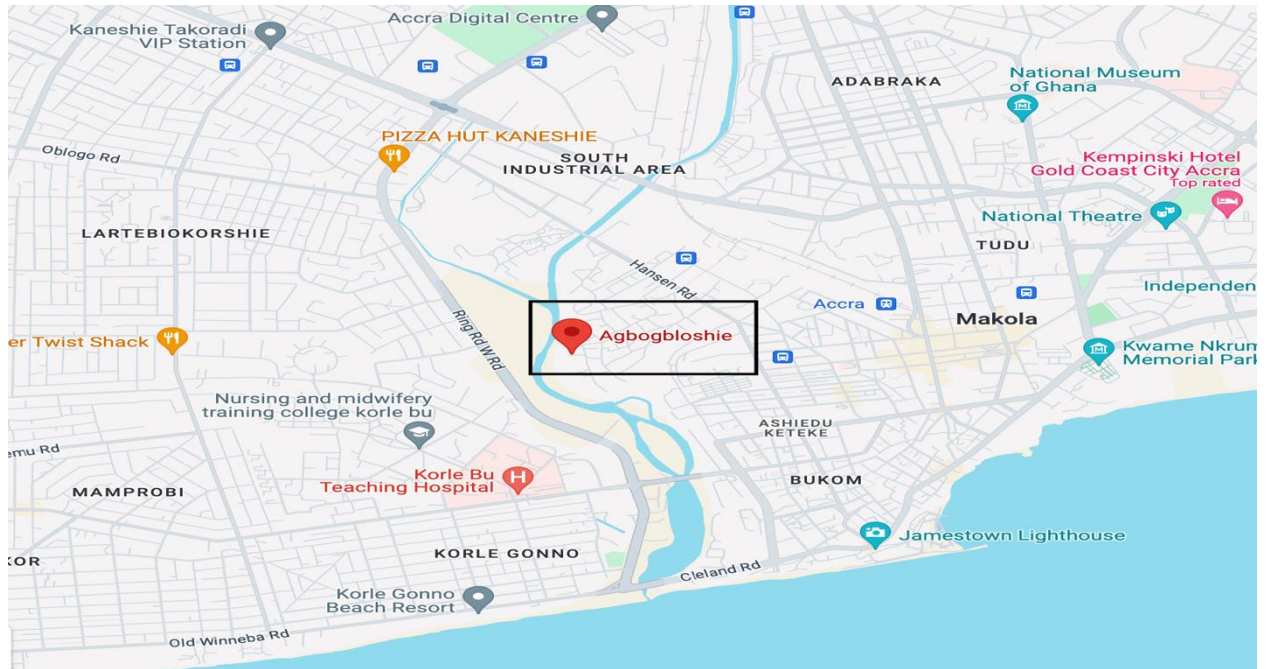


Map 2: Shiashe, East Legon study area

Source: Google Maps

Agbogbloshie

The landscape of Agbogbloshie has significantly changed due to human activity, especially the growth of informal settlements and waste accumulation (Akeso, 2019). The polluted Odaw River passes through the area and contributes to rain-induced flooding in the area (Balstrom et al. 2024). Agbogbloshie is a densely populated commercial district positioned in the center of Accra. The population of Agbogbloshie comprises of economic migrants from rural parts of Ghana in search of employment opportunities (Castellanos, 2022). It is considered an economically disadvantaged neighborhood and comprises of informal structured including overcrowded tenements and makeshift shacks. Informal vendors who practice small-scale business are prevalent in the commercial scene. Similar to Shiashe, East Legon, the area has undergone rapid urbanization, but Agbogbloshie has more informal settlements. Amoako & Frimpong Boamah (2020) asserts that these informal settlements and urbanization have contributed towards vulnerability to the impact of floods in the Agbogbloshie region. The problem is exacerbated by fact that at Agbogbloshie, there is large e-waste and scrap metal dumpsites that contribute to pollution and biophysical hazards that clog available drainages leading to a high flood risk in the area (Amoako, 2018). The area receives seasonal rain with the main season is lasting from April-July and the minor one from September to November.



Map 3: Agbobbloshie study area

Source: Google Maps

1.5 Research Gaps

While many studies have examined vulnerability and implications of floods in Accra (Afeku, 2005; Aboagye, 2008; Karley, 2009; Amoako & Frimpong Boamah, 2014; Amoako & Inkoom, 2017; Yankson et al., 2017; Frick-Trzebitzky & Bruns, 2019) only few studies have critically delved into the sociopolitical and socioeconomic factors influence vulnerability and coping capacities of actors. This study hopes to contribute and further enrich research on such factors in flood reduction efforts. Furthermore, fewer studies have examined the knowledge of individuals and households about coping with the implications of floods. Through the examination of the lived experiences of Shiashie, East Legon and Agbobbloshie, this study wishes to feature their knowledge on adaption and coping with flood implications.

1.6 Research Questions

Main research question:

How do socioeconomic factors influence the vulnerability to the impacts of floods and coping mechanisms of the inhabitants of Shiashie, East Legon and Agbobbloshie neighborhoods?

Objectives

1. To identify the differences in perception and assessment of risks in the two areas?
2. To identify and analyze the coping mechanisms employed by residents of Shiashie, East Legon and Agbobbloshie in response to urban floods.
3. To examine how socioeconomic factors influence vulnerability of Shiashie, East Legon and Agbobbloshie communities to urban floods.

1.7 Justification and Significance of the Study

There is need to improve the preparedness and adaptation of individuals and households by capturing, incorporating and circulating local knowledge in preparedness and response strategies and making these strategies bottom-up driven. Frick-Trzebitzky et al. (2017) assert that limited comprehension of local conditions can make invisible the vulnerability to the impacts of floods as well as groups of individuals, consequently aggravating policy failure instead of reducing the risk to floods. Further underscoring the significance of context specific knowledge and attitudes about vulnerability to the impacts of floods and preparedness for developing enhanced policy interventions and strategies, the findings of Christian et al. (2021) demonstrated that household background characteristics have implications on the perceived vulnerability and capacity to adapt to floods in Ghana. It is hoped that the current study will provide a comprehension of how floods affect different socio-economic groups of Accra. Such a comprehension is relevant for creating targeted responsive strategies and address the explicit needs of different communities. International agencies, state departments and non-governmental institutions can employ the findings of this study in both urban development and flood risk reduction in Accra.

Chapter 2 Literature Review

2.1 Contextualizing Vulnerability

2.1.1 Defining vulnerability in the context of flooding

The concept of vulnerability covers multiple disciplines which has led to multiple definitions hence the need to narrow it down to the context of natural hazards such as flooding. The International Panel on Climate Change defines it as the extent to which a system is susceptible to or unable to cope with the adverse effects of climate change and extremes of climate variability (IPCC, 2007). Specifically in relation to flooding, Adjei-Darko (2017) define vulnerability as the capability of or susceptibility to being physically hurt or damaged.” When it floods, there is always the possibility of life, infrastructure and the economy being vulnerable. Biophysical factors that impact vulnerability include type of buildings, aptitude to forecast and strategise for forthcoming hazardous occurrences, degree of built-up areas, nature of population such as mobility, health and age as well as land cover and land use (Panayotis et al., 2008). This suggests that even though the exposure level and risk to flooding may be uniform in a particular flood hazard region, there may be dissimilar ranks of vulnerability based on the indicated factors. Mishra (2018) constructed four classes of flood vulnerability. The four are social vulnerability, infrastructure vulnerability, economic vulnerability and physical vulnerability. In the study, social vulnerability was described as reaction, response, and resistance of a population to disastrous events; economic vulnerability as including flood damage expressed in monetary terms; physical vulnerability as incorporating only those indicators susceptible to biological sensitivity; and infrastructure vulnerability as encompassing civil structures (Mishra, 2018). The different classes of vulnerability highlight the distinctive ways through which vulnerability may be evaluated.

In this study, vulnerability is explored in the context of an environmental hazard; flooding and socio-economic factors. Vulnerability to environmental hazards can be described as the characteristics and situations that influence a person’s or group’s capacity to cope, resist and recover from the adverse effects of natural hazards (Blaikie et al., 2014). It can also be seen as the extent to which a system is susceptible to, or unable to cope with, adverse effects of climate change and climate variability extremes such as floods (Biswas & Nautiyal, 2023). In the context of socioeconomic factors, it can be described as a situation individuals are vulnerable to floods due to factors such as wealth, education, race, ethnicity, gender, age, disability, and health status (Munyai et al., 2019).

2.1.2 The Concept of Vulnerability

While conceptualizing vulnerability, Adger (2006) argued that the vulnerability of any system is influenced by the socio-ecological resilience to natural disasters. Moreover, he considers endowment, inequality, livelihood threats, and lack of institutional resilience as critical factors that lead to vulnerability. On the other hand, Biswas & Nautiyal (2023) considered vulnerability from two perspectives, the risk hazard (RH) approach and the PAR Model. Risk hazard explores hazard as a physical exposure while the Pressure and Release (PAR) model offers a framework that can be used to analyze underlying risk factors contributing to vulnerability and hazards in a community. The model makes it possible to examine the social, political, and economic systems that contribute to vulnerability. It describes vulnerability as occurring from those natural hazards and the processes that generate vulnerability. In this instance, flooding is a natural hazard while the progression of vulnerability for communities

is influenced by root causes, dynamic pressures, and unsafe conditions (Biswas & Nautiyal, 2023). The root causes are concerned with deep-rooted issues that lead to unequal distribution of power, weak and access to resources including political systems, economic systems, inequalities, and poor governance. On the other hand, dynamic pressures are the processes and activities which turn the root causes into unsafe conditions resulting in vulnerability. For instance, rapid urbanization, poor infrastructure, and environmental degradation activities are among the activities that could create unsafe conditions that expose individuals to vulnerability (Aziz, 2018). The unsafe conditions under the model are the tangible factors that create vulnerability for populations. For example, living in hazard-prone areas, unprotected buildings and infrastructure, poor access to basic services such as education and healthcare, fragile livelihoods (including livelihoods at risk and low income), and lack of disaster preparedness are all factors of unsafe conditions that lead to vulnerability (Aziz, 2018). Therefore, vulnerability arises when root causes lead to dynamic pressures that create unsafe conditions.

The release phase of the model emphasizes on reduction of vulnerability where addressing root causes will result in improving conditions and building resilience. In summary, vulnerability to the impacts of flooding can be viewed as arising from the dynamic intersection of natural hazards and human systems where addressing the pressures and unsafe conditions can help reduce the overall risk of communities to the impacts of flooding. Therefore, the understanding of the various systemic inequalities and pressures that lead to unsafe conditions can be instrumental to policymakers in the identification of how the issues can be tackled to reduce vulnerability. Bankoff et al. (2013) view vulnerability as a social construct where people are considered the central aspect when evaluating vulnerability. This brings about the need to evaluate vulnerability beyond natural disasters to focus on the people and communities to understand the risks and vulnerability that are likely to be faced from the perspective of political, social, and economic practices and institutions (Biswas & Nautiyal, 2023). This lays the foundation for exploring vulnerability from the lens of society and how people interact with natural hazards in an attempt to understand their experience when faced with events such as flooding. In other words, vulnerability is not a property of individuals or social groups but arises from complex social relations and processes surrounding them (Bankoff et al., 2013). This forms an important perspective as individuals in a given region are not innately vulnerable but due to the interaction of different facets in their lives. This leads to Bankoff et al. (2013) arguing against the use of general vulnerability charts and emphasizing the importance of conducting an analysis to understand the dynamics that make certain groups vulnerable.

2.1.3 Political Ecology of Vulnerability Assessment

Although the primary focus is on socioeconomic, the political environment also interacts with social and economic pressures thus playing a component in influencing the outcomes of populations. Pulwarty & Riebsame (1997) posit that the political ecology offers a frame for comprehension and incorporation of social constructions of vulnerability. From a political ecology perspective, vulnerability is not an intrinsic characteristic of groups or individuals, rather it is entrenched in an amalgamation of political, economic and socio-ecological factors that are influenced by policy environments. Such a perspective mirrors the convergence of human ecology and political economy and indicates ways in which vulnerability is engrained in institutions, values, the environment and people. As a hazard, flooding is considered a risk through its social production where vulnerability to impacts of flooding is as much a consequence of power relations and political decisions, as the result of environmental change (Collins 2009: Elmhirst et al., 2017). Following the political ecology line of thought Frick-Trzebitzky et al. (2017) study on the production of vulnerability in Accra established that even when risk can be spatially quantified, vulnerability to the impacts of floods varies

based on institutional dynamics, property rights, class and gender. This underscores the importance of considering the institutional framework that is in place and how it influences the vulnerability of the population. Adger (2006) acknowledges the challenge posed in the analysis of governance implications on vulnerability and elevates the role of policy interventions in promoting resilience and reducing vulnerability. In this study, the political aspect of vulnerability is explored in terms of its implications on the residents' socioeconomic factors. In essence, the exploration is narrowed down to how institutional factors from the regional authorities plays a role in influencing the vulnerability outcomes of community members in Accra, Ghana.

2.2 Influence of Risk Perception on Vulnerability

Examining risk perception seeks an understanding of how community members evaluate the likelihood of danger and the possibility of adverse outcomes when exposed the floods. Mishra (2018) describes three components of flood risk as including hazards (the natural events that create a threatening environment), exposure (the values/humans that are present), and vulnerability (lack of resistance to the impacts of the natural event). The view of risk provides insights into how it is related to vulnerability where the greater risk perception is related to greater levels of vulnerability. Moreover, Mishra's description helps in understanding that while an area may have the same hazard and even the same exposure or risk, individuals may still experience a wide range of vulnerability levels leading to different outcomes when exposed to the impacts of flooding (Mishra 2018). Similarly, while vulnerability can be measured using objective tools such as mortality, income, and access to education, Adger (2006) acknowledges the importance of perceptions of those who are vulnerable since the perception or experience is different in individuals or across population groups. Therefore, taking into account the viewpoint of communities is crucial to improving the comprehension of how people feel vulnerable to the effects of flooding. This serves as the foundation for assessing how individuals face different outcomes whilst being exposed to the same flooding risks potentially because of specific factors related to vulnerability and resilience to the effects of the natural disasters.

The dynamics, intensity of vulnerability, and sustainable livelihoods and hazards traditions need to be taken into consideration when measuring vulnerability. A perspective for examining people's capacity to sustain their livelihoods and bounce back from calamities is provided by the livelihood vulnerability framework. Etwire et al. (2013) claim that the framework makes it possible to understand the degree to which livelihoods are impacted by stressors like natural catastrophes. It gives the chance to measure how communities will adjust to shifting environmental conditions through a vulnerability assessment. Because of this, it is important to take into account how much flooding events impact livelihoods.

Another related idea of sustainable livelihoods, which aims to explore how people's access to resources including natural, human, social, physical, and financial capital lead to sustained livelihoods is introduced by Reed et al. (2013). This makes it possible to examine the effects of natural disasters like flooding on population outcomes. According to Reed et al. (2013), the hazards may result in less livelihoods options and increased poverty, which may further affect a population's ability to adapt. Furthermore, assessing a household, community, or system's capacity to deal with, adjust to, or recover from the effects of hazards helps determine how vulnerable it is (Smit & Wandel, 2006). Adaptive capacity is also included in the livelihood vulnerability index as one of the factors that influence outcomes and it can evolve to accommodate environmental hazards and increase the range of variability that people can cope with them (Brooks & Adger, 2005). As a result, evaluating livelihoods and adaptive capability might provide valuable information about vulnerability.

2.3 Coping strategies for floods

2.3.1 Defining Coping Strategies

Coping strategies have been defined as the cognitive and behavioural efforts made by individuals to deal with environmental factors that compromise their welfare (Lazarus & Folkman, 1984). It has been described as the community's strategy in dealing with floods (Charisna, Hamidah & Adib, 2018). Also, Gyekye, & Darko (2022) refer to coping strategies as the survival mechanisms that people use to deal with floods. They can also be defined as the mechanisms by the community to anticipate future changes in hazardous and vulnerable situations using past experiences to modify current practices (Uwayisenga, Adelekan, & Oguge, 2024). In this study, coping strategies will be defined as the practices and strategies by people and communities to mitigate or deal with the vulnerability arising from flooding events.

2.3.2 Coping Mechanisms, Resilience and Relationship with Vulnerability

Different coping and adaptive mechanisms have been adopted by people in an attempt to moderate the effects of floods. For instance, the analysis by Antwi-Agyei *et al.* (2023) on the drivers and coping mechanisms for floods in Urban Kumasi, Ghana found that individuals would consider temporary migration to deal with the adverse effects of flooding. Although communities may alleviate their current challenges while dealing with flooding, relocating back to the same flooding plains guarantees they will remain vulnerable (Antwi-Agyei *et al.*, 2023). Social capital can help promote the resilience of communities, enhance preparedness, mitigate the negative impacts of flooding, and accelerate the response and recovery process (Abunyewah *et al.*, 2023; Savari, Jafari, & Sheheytavi, 2024). An adaptation mechanism has been the modification of physical structures such as raising foundations of new buildings above flood level and constructing wider and deeper draining facilities (Carter *et al.*, 2015). The modification of structures can provide an effective strategy to mitigate the impacts of flooding. However, communities are still likely to encounter challenges where projected flood levels vary over time which can be exacerbated by poor construction and maintenance of flood mitigation structures (Amoako & Boamah, 2015). Moreover, Sohn *et al.* (2020) suggest that conveyance systems such as drainage systems vary by facilities and environment with storage-based systems likely outperforming them.

Researching on the coping mechanisms of communities around Weija Dam in Accra, Owusu-Ansah *et al.* (2019) discovered that the households affected by flooding tried to lessen its impact by pumping water out during flooding events, strengthening walls, erecting structures with sandbags and stone, and constructing drains. Nevertheless, these measures by locals have not yielded much success in the mitigation of the implications of floods. The study by Almoradie *et al.* (2020) also highlights cultural strategies exemplified by religious beliefs involving praying and fasting to a supreme being to not be affected by flooding. These beliefs may help people cope with the adverse events arising from the impacts of floods. While community beliefs can help people interpret natural hazards and perceptions, the impacts on vulnerability may vary depending on the nature of beliefs. In particular, some beliefs may be fatalistic leading to poor self-efficacy while others may support a care-oriented and mitigation-oriented management approaches (Ha 2015; Sun, Liu, & Yang, 2022).

Another adaptive strategy has been accessing climate information and communication gadget to acquire knowledge about risks and take timely actions (Mabon, 2020). Access to climate information helps reduce vulnerability by mitigating the impacts of flooding. In

particular, individuals and communities can access climate information and environmental knowledge which allows them to act before failures and harm can occur from flooding events (Mabon, 2020). Knowledge of the environment helps build resilience and allows societies better managing the risks and opportunities arising from climate variability (Hewitt, Mason, & Walland, 2012). The different strategies and mechanisms can be useful in helping people cope with the adverse impacts of flooding while also influencing their vulnerability outcomes.

2.3.3 Factors Influencing Coping Strategies and Perception of Vulnerability

A range of factors are likely to influence how people perceive vulnerability and the coping strategies they use. For example, economic factors could affect the capacity of vulnerable households to cope with the impacts of floods. In the study by Gyekye and Darko (2022), it was found that disparities in income and asset distribution tend to increase higher risk of exposure resulting in the poor and vulnerable households becoming even more vulnerable. However, Osberghaus (2021) suggested that poor and low-income households have fewer and less valuable assets and thus face lower monetary risks compared to the wealthy. Nevertheless, evidence has shown that the poor face low resilience to loss and lack spare capacity to absorb income loss resulting in greater risks including falling further into poverty and increased future vulnerability (Hallegatte *et al.*, 2016; Safiah Yusmah *et al.*, 2020). Indeed, Osberghaus (2021) acknowledges that relative to the available financial budget, damage weighs higher for low-income households. As people from poorer are unlikely to have enough resources to counter the impacts of flooding and adopt adequate coping strategies to mitigate future vulnerability.

Also, occupation status and education levels can have an impact in the way households coping with negative impacts of flooding. In particular, coping decisions are likely to be influenced by factors such as reliance on agriculture and subsistence farming likely increasing the risk of vulnerability (Mondal, Murayama, & Nishikizawa, 2020). Also, as noted in Uwayisenga, Adelekan & Ogue (2024), education can help raise awareness for natural disasters and promote readiness of vulnerable communities. In contrast, communities that have lower education levels or limited formal education are likely to have poor awareness and knowledge of disaster risk management which affects their decision-making when dealing with the impacts of floods (Okeleye *et al.*, 2016). Therefore, people and communities can experience different risks and vulnerabilities associated with their work and levels of education and how they deal with the perceptions and coping choices.

The adaptive capacity of communities can be influenced by innovation. This is demonstrated by Mutenje (2021) where it is argued that people's capacity to change their behaviour and embrace new technologies and practices to boost resilience is a valuable tool that can support communities in overcoming calamities and promoting change. Communities that value innovation are likely to better able to adapt to and lessen the effects of flooding. Community beliefs can also influence how people perceive and react to impacts of floods. For instance, social stigma can have a negative impact on coping strategies. For example, some people may view financial aid as stigma since it challenges their role as breadwinners or makes them no longer members of middle class (Crowley, 2021). Another factor is how people in the community believe the responsibility for flood mitigation measures should be assigned. As pointed out Mind'je *et al.* (2019), many communities tend to consider the government as responsible for flood mitigation measures. As a result, the many communities end up being increasingly vulnerable to potential negative outcomes due to lack of preparedness, low perception of floods, and poor adaptive capacities (Uwayisenga, Adelekan, & Ogue. 2024). Hence, the beliefs and expectations that communities have could negatively

impact their perception of vulnerability and lead to poor coping mechanisms against the impacts of flooding.

2.3 Social Vulnerability Theory

A community's social vulnerability is defined as a condition whereby the community lacks the necessary resources and capacities to cope with disaster due to factors such as discrimination, poverty, social exclusion and isolation (Fothergill & Peek, 2004). Likewise, inhabitants of flood prone regions or the floodplain, are at high risk of floods and all related perils. The poor with limited access to transportation may also have a problem with evacuation during floods, or seeking assistance from the emergency response team (Guddo, 2024). In addition, individuals or groups of individuals who are discriminated or socially excluded may be faced with other challenges in flood preparedness, management, and recovery.

According to the Social Vulnerability Theory, social and economic variables also have an impact on floods in addition to environmental dangers. The theory also stipulates that in order to lessen vulnerability to disasters, which are mostly brought on by inequality and marginalization, policies and programs that address these underlying socioeconomic reasons are always required (Blaikie et al., 2014). It is useful to understand how certain groups of people are more vulnerable to disasters and their adverse effects than others due to social, economic, and political factors (Guddo, 2024). The social vulnerability theory, as explained by Thomas et al. (2013) and Yoon (2012), holds that some groups are more likely to experience adverse consequences in the event of flooding disasters because of their social vulnerability, which might include characteristics like age, gender, membership in certain racial or ethnic groupings, disability and socio-economic status.

As pointed out by Ogie et al. (2018) social exclusion entails barriers to communication and access to information on flood warnings and evacuation plan such as linguistic and cultural barriers. This makes them exposed to high levels of vulnerability especially in the event of floods. Furthermore, the idea of social vulnerability places significant focus on the social elements that heighten individuals' susceptibility to flooding disasters (Guddo, 2024). Therefore, in order to lessen the disparate effects of floods on various groups within the community, policymakers and emergency responders must identify vulnerable populations.

2.4 Conceptual Framework

A conceptual framework is developed that summarises the proposed relationship between risk factors, coping mechanisms, socioeconomic factors and flood risk.

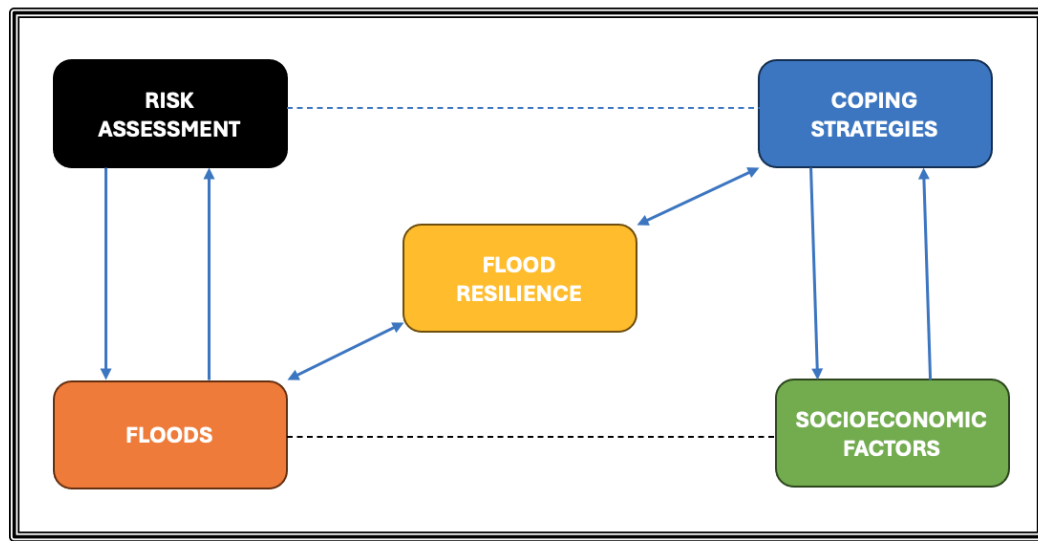


Figure 1: Socio-economic factors' Influence on Flood Vulnerability

I used the above figure to connect five concepts which were related to this study.

Firstly, Risk assessment is crucial in informing adaptation strategies for flooding patterns. Guddo (2024) explains that risk assessment helps to identify the areas that are most vulnerable to flooding so that policymakers can take effective measures to reduce exposure and minimize the damage for individual and community.

Furthermore, Flood resilience is concerned with the ability of individuals, communities and systems to recover from a disaster and adapt to future challenges (Guddo, 2024). Therefore, a flood mitigation framework should examine the factors that contribute to resilience and how it can be built and strengthened in the context of flooding disasters.

Finally, Flooding often affects marginalized communities disproportionately. Therefore, it is essential to explore the socioeconomic factors that contribute to this inequality and how it can be addressed through better policies and programmes. Effective disaster response must consider the socioeconomic factors that affect communities differently. The marginalized communities that lack access to healthcare, clean water, or emergency services, may be more vulnerable than others in the aftermath of flooding.

Chapter 3 Methodology

4.1 Introduction

This chapter highlights the steps followed while carrying out research on the vulnerability and coping mechanisms of the Shiashie, East Legon and Agbogloboshie communities in Accra, Ghana. The research approach, design, sampling techniques, data collection and analysis, ethical considerations, as well as the limitations of the research are provided in detail.

4.2 Research Approach

The study adopts a qualitative research approach to explore the opinions and experiences of residents. It is considered appropriate to employ qualitative methods in this study as it would allow in-depth understanding of the opinions, experiences, and attitudes towards flooding vulnerability in the respective regions. This research also incorporates primary data which is collected specifically for the purpose of the research being conducted at the time of the study. Primary data was collected from views and experiences of residents to get first-hand understanding of their flooding vulnerability and coping mechanisms. This will help the analysis to have a better view of vulnerability to the impacts of floods and coping mechanisms.

4.3 Research Design

The study uses a cross-sectional case study design that targets Shiashie, East Legon and Agbogloboshie as two different cases depicting different social economic and environmental conditions in Accra. Analyzing the two regions will help provide clarity in the representation of the experience of vulnerabilities by communities when faced by the impacts of flooding. In particular, the two regions will allow getting a broader perspective rather than being limited to one region thus increasing the accuracy of evaluating vulnerability, coping mechanisms, and socioeconomic factors. Hence, it will be suitable in the collection of qualitative data to examine how different conditions influence how vulnerable the communities are to the impacts of floods through the unique experiences and perspectives from each region.

Shiashie, East Legon which is an affluent well planned and developed community is in stark contrast with Agbogloboshie, a poor slum area with high population density and poor infrastructure. Notwithstanding these differences, both regions are prone to flood with different extent and effects as well as measures taken. Thus, a comparison of the two communities will give an understanding of how social and economic factors and infrastructure affect vulnerability and resilience. This is because the flood events considered happened in the two communities within the recent past, thus making the data collected to be up to date. The case study will provide a realistic setting which will enable the investigation of the research questions in relation to vulnerability, coping mechanisms and the influence of socioeconomic factors in community resilience. However, since cross-sectional studies only focus on a single moment in time, they provide a snapshot and are unlikely to provide clear causal relationships limiting generalizability (Wang & Cheng, 2020). For instance, the design will only provide observations within the current weather conditions and may not appropriately reflect the vulnerabilities experienced before, during or immediately after the flooding events. Hence, it cannot be used to establish long-term vulnerability trends of the communities.

4.4 Sampling and Participants

The method used in the study is stratified purposive sampling in order to select participants. It is a non-probability sampling technique in which I intentionally select participants with the purpose of the study and with the belief that each of them has something new to contribute to the study. The population of interest is selected from the two regions which help in collecting the unique perspectives from each to get a broader perspective on the characteristics related to vulnerability to the impacts of floodings. Therefore, the population is divided in to two groups in terms of geographical location and economic status. This means that the research is able to get a variety of opinions from different groups within each of the communities. In order to make the primary contacts, I utilize local groups and contacts as well as community leaders. Others are enrolled through snowball sampling until the required sample size is reached since some subgroups of the population were difficult to reach or reluctant to participate.

The study sought to ensure that it got data from different residents and key informants from the two communities involved in the study. I, therefore, recruited fifteen respondents from Agbogbloshie and another fifteen from Shiashie, East Legon. The research aimed at including residents from varied backgrounds to ensure that the study captured broad experiences on flooding and coping mechanisms. As a purposive sample, the selected participants have experience with flooding and they were willing to take part in the research. Other key members of the sample were municipal employees from Shiashie, East Legon and Agbogbloshie who acted as informants in the research. Each community produced two municipal employees who have experience in community development, disaster management, and urban planning. The rationale for including them was that they gave valuable insights into the official response to flooding and also into the policy and structural factors that make communities vulnerable to such disasters. Another set of informants consisted of four community elders – two from each community. They were included because they understand the social dynamics, local history, and traditional coping mechanisms better.

4.5 Data Collection

Data was collected through semi-structured interviews and field observations. The purposive sample of residents and informants was interviewed through semi-structured interviews, where each one of them gave their perspective on the topic. The interview consisted of both open- and close-ended questions, allowing subjects to talk about their experiences with flooding and the strategies they used to cope with the effects. They were one-on-one interviews lasting between 45 minutes to one hour and carried out in English or the local languages spoken by those communities. Informed consent was sought before the interviews and an audio machine used to record the interviews. I also carried out field observations in the areas that were most vulnerable to flooding in Shiashie, East Legon and Agbogbloshie. During the observation, they took note of the infrastructure, environmental conditions, drainage systems and the nature of waste management.

4.6 Data Analysis

After completion of data collection process, analysis was carried out and presented according to type of data collected for each study. First, the audio recording of the interviews was listened to and then the interviews were transcribed and read through the field notes to help in understanding the data and its completeness and accuracy. This was followed by the coding step in which codes were given to the data sets. The initial codes were generated from

the data by reading through all the data and searching for concepts that seem to be related. These were then categorized into different themes and subthemes which corresponded with the objectives of the study. These themes are the major themes and sub-themes that were identified from the data since all the related codes were grouped to form the themes. Then they were compared to the coded data to validate if the themes that were generated are in line with the data that was analyzed. After that the process of coding and naming the themes took place. I also went through the field notes to further validate that the themes matched the responses obtained from the participants. Information gathered from secondary sources was analyzed using content analysis. This was vital in developing patterns, themes and trends from the literature that was reviewed on flooding and coping mechanism. In order to be able to arrange the information extracted from the secondary sources, they were put into different categories. This was useful in establishing how the identified ideas relate to the literature and the disparities as regards to how different issues are expressed.

Qualitative data were examined using triangulation method so as to have a different perspective of the collected data. What it does is that it utilizes different data sources and methods and viewpoints in order to come up with a comprehensive finding on the research question of interest. This was in line with the research design of the study whereby, qualitative data collection tools were used at different time in order to corroborate strength of one method as well as avoiding weakness of the other method. It was also applied in increasing credibility and dependability of the findings from the main data collection instrument and in verifying the numerous sources of secondary data that presented diverse perspectives over the research theme and gaps. During the integration process, the insights and themes from the field observations, interviews, and literature search were compared and contrasted for similarities and differences. This way, the research was able to identify consistencies and discrepancies in the subjective experiences of the two communities as well as the broader policy and theoretical contexts. The analysis resulted in the identification of the primary factors that play a role in community resilience and vulnerability to flooding.

4.7 Ethical Considerations

Consent was obtained from individuals before they were selected to participate in the study. The step was to inform the participants on the study, the type of data that would be collected from them and how the data would be used. Then the participants were asked if they agreed with the information provided to them including their right to withdraw from the study at any given time and they signed a consent form to show that they agreed to participate in the study. This was to ensure that the participants in the study engaged in the study voluntarily and that they comprehended their rights during participation. The study also aimed at ensuring that the participants' rights were protected as far as the research ethics are concerned, particularly on issues of confidentiality. To ensure the confidentiality of the study I ensured that all measures were taken to ensure that any information that could be used to identify the participants or the organizations was not recorded or documented. Such information that can be used to identify the participants were anonymized in order to protect the participants' privacy. Including this step in the consent form help participants feel comfortable to share their experiences, as they were confident that I would not disclose their identities or any other information linking them directly to the study. I also took the consideration of preventing harm to respondents. To avoid causing harm, I avoided uncomfortable or sensitive topics that could distress participants. I also considered the physical safety of participants. This was particularly evident while carrying out field observations. The study was designed and carried out with a focus on minimizing risk and upholding the well-being of the participants.

Chapter 4 Findings and Discussion

5.1 Demographic Data

The study's sample included fifteen residents of Agbogbloshie, fifteen residents of Shiashie, East Legon, 2 employees from Shiashie, East Legon municipality offices, 2 employees from Agbogbloshie municipality offices, 2 community elders from Shiashie, East Legon and 2 community elders from Agbogbloshie community. The participants were asked their age group where they could select one the options provided. From the data collected, both communities were found to have people from 40 and above living and working around there more than 18-28 and 29-30. This would imply that the younger population are likely to find a way to relocate and live or work in other places potentially due to the issue of flooding. All of the participants from Agbogbloshie have lived there for 8 years or more which would imply an attachment to the region despite the difficulties faced. For Shiashie, majority of the participants interviewed (67%) have also lived in the region for 8 years or more with another 25% living in the neighbourhood for 2-4 years. As such, it is possible that a majority of the population have an attachment to the region despite of the challenges of floodings though a few are likely to move in or out of the region. For occupation, there are more people who are self-employed in both communities than those who are employed according to the participants interviewed. This could potentially be a reflection of the informal economy where investors are reluctant due to damages to production facilities causing losses for businesses. Communities in both regions have robust access to technology especially mobile phones which could provide access to climate information and flooding warnings.

5.2 Socioeconomic Factors Contributing to Vulnerability

5.2.1 Income and Employment

The research wanted to find out how different socioeconomic factors contribute to vulnerability to the impacts of flooding. The first aspect considered was the economic status of the communities in the different regions. Responses showed different levels of preparedness and recovery from the impacts of floods. Participants from Shiashie, East Legon were more likely to report being able to prepare and start afresh thereby recovering quickly. For example, one participant from Shiashie, East Legon reported "I am okay enough that floods don't halt my business." A likely explanation can be drawn from one of the participants who stated "My financial position allows me to prepare for floods." This can be attributed to the fact that residents in Shiashie were more likely to have a higher income and better employment which made them likely to be well-prepared for the potential adverse impacts of floods which likely makes them less vulnerable. In contrast, people with lower income and unstable employment terms may not have the means to cover or mitigate the losses caused by floods yet still encounter damage in terms of their property and living spaces (Hallegatte et al., 2020). Using income distribution obtained from the participants, residents in Agbogbloshie were likely to have low to moderate income levels. This could likely explain the reports by participants in the region facing trouble in affording basic needs such as food, or making repairs to their structures making the recovery process last longer after flooding. One participant in the community reported "I am not financially stable enough to prepare for or recover from floods." Another participated stated that "My financial situation makes it hard to prepare for floods. I can't afford things... recovery from floods takes a long time and is very stressful." The responses from residents highlight how income is one of the factors that create unsafe

conditions as those with low income are likely to be left to face hard times during flooding leaving them more vulnerability. Therefore, the vulnerability situation is different for people living in low-income areas.

Nevertheless, both low and high income endure the damages caused by flooding leading to decline in capital and affecting their financial stability (Caloia et al. 2023; Houston et al. 2021). This can be seen in the comment by a respondent stating “It makes our economic activities go down leaving us financially handicapped.” Despite owning businesses which could enable in theory lead to a better financial position, the adverse effects of flooding in term of business going down or destruction of properties would have a negative effect on their overall financial ability thus increasing the risks for the residents. However, exposure to similar adverse effects of flooding does not translate to the same vulnerability as having access to a higher economic status due to either better income levels, employment or larger and more stable businesses could help reduce vulnerable compared to those with lower income and lower economic status (Houston et al. 2021). Studies suggests that high flood risk vulnerability is concentrated among people from lower income households worldwide with vulnerability linked to poverty who are less likely to be prepared and suffer the most in the events of floods (De Silva and Kawasaki, 2018; Houston et al., 2021; McDermott, 2022). This also corroborated by the response from municipal employee indicating that residents who do not earn much are more likely to face difficulties in responding to flooding.

There is evidence suggesting that social differentiation in vulnerability to flood impacts is relatively small soon after a flood (Houston et al. 2021). Indeed, some of the respondents who reported to being prepared for floods acknowledged heavy rains and floods can cause a lot of damage to their housing structure. Nonetheless, the impact of social differentiation grows markedly over time. Although socially advantaged groups such as professionals and homeowners may be vulnerable to short-term impacts, they are less vulnerable in over a longer timescale compared to socially disadvantaged groups (Houston et al. 2021). The observations confirm the impact of low socioeconomic status on vulnerability to the impacts of floods. In particular, there is likelihood that high flood risk vulnerability is concentrated among people from lower income households worldwide with vulnerability linked to poverty (McDermott, 2022). Similar results can be seen in the study by De Silva and Kawasaki (2018) where those with low income are likely to be less prepared and are the most vulnerable to financial losses in the event of floods. Hence, income factors can have long-term implications to the vulnerability of the local population.

5.2.2 Education and Technology Use

Vulnerability can be influenced by education levels and technology use. There is little difference between the region in terms of their education levels. For instance, in Agbogbloshie, a large number of participants only have primary school education (46%) which is approximately similar to the proportion in Shiashie (47%). Other education levels in Agbogbloshie were 38% with secondary school and 15% with college education as compared to 27% with secondary school and 20% with college education in Shiashie. As such, there are more residents with high school education in Agbogbloshie but there are more with college education in Shiashie, East Legon. Distribution in education patterns provide insights into how education level can influence vulnerability and perception of risk. Higher education levels are associated with better understanding of flooding forecasting and capturing early warnings thus reducing both physical and psychological damages caused by the impacts of flooding (Paul & Routray, 2010). The slightly higher college education levels in Shiashie could be interpreted as the population facing lower vulnerability and perception of risk due to ability to keep track and adequately understand forecasts and warnings.

The level of access to technology is could impact the perceived risk to the vulnerability of impacts of flooding. From the responses of the residents, there is high access to technology such as mobile phones, TVs and radios in both Agbogbloshie and Shiashie, East Legon. Hence, the community members have high level of access to technology offering them the opportunity to access news, forecasts and climate information related to flooding. Prompt access to information on flood warning and evacuation plans can be instrumental to helping communities respond appropriately and take actions that could help reduce risk of damage (Ogie et al., 2018). As such, a lack of access to flood warning is unlikely to be a differentiating factor for communities in both regions since members in both have access to technology with mobile phone usage being greater than 90%. Therefore, evaluating technology by itself does not yield significant insights in terms of differences between the two regions.

A key aspect that can be incorporated when evaluating the potential impacts of technology is education levels and how it is likely to affect their capacity to use technology to get climate information and potential warnings of oncoming floods. This is due the likelihood of education being a modifying factor that influences social vulnerability despite the similarity in technology availability. Low education is a problem that could increase social vulnerability as individuals do not have special knowledge or technical skills making the population less empowered and thus more vulnerable to disaster (Aziz, 2018). On the other hand, individuals with higher education levels might have a slight advantage in using their ability to understand and interpret forecasts which could help them prepare and reduce the risks associated with flooding (Cerulli et al., 2020). This could work in favour of communities with higher education levels such as those in Shiashie resulting in better risk assessment and preparation in response to climate information and flood warnings. It was not clear weather residents in either community were relying on forecasts or using climate information to make early planning which would likely make the expected differences in interpretation due to education level less relevant.

5.2.3 Social and Communal Support

The findings reveal different perspective on the role of social factors. In particular, a number of residents in Agbogbloshie reported little help or support from neighbours. Some of the responses included “The community does not support itself” and “Nothing of the such sort.” In Shiashie, East Legon, some respondents highlighted the poor attitudes and behaviour of residents. For example, the responses included “They dispose waste anywhere”, “We don’t clean the gutters”, and “The people have bad waste management practices.” A key observation from the findings is the stratification for social factors does not seem to have any distinct differences between the two regions. In essence, social capital is largely based on specific locality rather than overall regional generalization. The observation can be explained by looking at the specific communal environment and how individuals relate with others in their locality. In particular, neighbourhood or community resilience is an important factor that can help in coping with disaster situations where social capital can help increase coping capacity (Prall *et al.*, 2024). The results from both Agbogbloshie and Shiashie, East Legon reveal that some residents experience limited social capital as they indicated they go through challenges alone. The who reported little to no social support in the neighbourhoods are likely to face higher levels of risks as they do not have enough capital to deal with the challenges or the resulting impacts of floods (Kyne and Aldrich, 2020). This would make more vulnerable to adverse consequences as they have to deal with the impacts of floods on their own. The local social relations can play a role in influencing the conditions that could potentially increase or decrease risks. In this case, both regions have local areas where there is limited social support where the community are not organised toward addressing some of the simple issues that could help reduce the impacts of floodings. For such residents, they

are likely to encounter higher levels of vulnerability as the lack of community initiatives results in the local areas remaining unsafe.

However, some responses revealed some level of communal support. For example, one respondent in Shiashie, East Legon indicated “We all come together to desilt the gutter.” Similarly, another in Agbogbloshie said “We help each other during these times.” Therefore, for these residents, they report having excellent social support where they work together to address factors that contribute to flooding such as desilting and help each other during times of trouble. As a result, they experience better social capital which could result in improved coping capacity and thereby having reduced vulnerability to the impacts of floods (Kyne and Aldrich, 2020). This implies that communal support is likely to vary from one individual to another with no defined pattern in each of the regions. The findings provide insight into the diverging perspectives towards the impact of social capital even for those in the same region. The markedly different views implies that social capital varies between individuals, families and communities in a particular region with no clear stratifications. For these residents, the social capital and sense of community helps minimise the potentially unsafe conditions in their local areas which results in some reduction in vulnerability. Therefore, communal support is likely to vary from local area to another in either of the regions resulting in some individuals being disproportionately disadvantaged and vulnerable compared to others due to their social capital.

5.3 Risk Assessment

5.3.1 Perception of Flood Risk and Contributing Factors

In terms of risk assessment, the research looked at the perception of flood risk and effect of flooding in the neighbourhood. The findings reveal that the leading perceived factors causing flooding in both Agbogbloshie and Shiashie, East Legon are clogged drains, poor design of drain infrastructure, and improper waste disposal practices. In addition, residents in Agbogbloshie also reported lack of adequate drains, low-lying nature of the relief, unplanned settlements and building on/close to water resources as other factors that contributed to the risk of flooding. For example, one participant Agbogbloshie reported that “People throw wastes everywhere clogging drains which causes it to overflow.” As such, improper waste disposal is potentially one of the main contributors to flooding due to its effects on the logging of drains. Similarly, a resident in Shiashie, East Legon indicated “the people in my community are found of bad waste management practices.” The response highlights that the community still faces some degree of improper poor waste disposal practices. Nevertheless, the residents in Agbogbloshie are likely to have greater vulnerability due to having one of the largest e-waste dumping site which is an indicator of poor waste disposal practices (Akesse & Little, 2018). Besides, living closer to a river result in being more susceptible because of their state living because of their state of living especially for those who are migrants from other regions of Ghana. The poor disposal practices contribute to clogging of drains which combined with its location closer to a river result in residents living in Agbogbloshie being vulnerability to greater impacts of flooding.

On the issue of lack of adequate drains, a resident Agbogbloshie indicated stated “The drains are not designed good and they can’t handle water from floods. This makes it easy for the area to flood.” Similar views were expressed by resident in Shiashie, East Legon. As such, poor drainage design combined with poor waste disposal practices could greatly reduce the volume that drainage systems handle contributing to the flooding problem. Agbogbloshie also faces the issue of informal settlements in Agbogbloshie which further complicates the development of waste management systems and promotes dumping and increases the

perceived risks to the impacts of flooding (Amoako, 2018). The findings provide insight into the interaction of different pressures that lead to community residents facing vulnerability to the impacts of flooding. While living in hazard-prone areas is among the unsafe conditions in the PAR model which create vulnerability for populations in that particular area, it is also evident that the activities of the community can also be a contributory factor to creating unsafe conditions. The activities of residents act as dynamic pressures that serve as root causes for unsafe condition in a local area (Biswas & Anwaruzzaman, 2019). In this case, the action of poor waste disposal leading to clogging of drains provide a classic example of how the residents in Agbogbloshie contributed to an increased level of vulnerability in the region. Therefore, unsafe conditions can arise from the poor actions and activities engaged by local residents that lead to higher risks when flooding events occur.

Rapid urbanization is one of the dynamic pressures that contribute to the progression of vulnerability. As a result, as more structures continue to be put especially with little planning, unplanned settlements are likely to arise that get in the way of drainage systems and obstruct flood water from flowing. This works to increase the effects of flooding by creating unsafe living conditions for the residents as flooding risk increases and residents more likely to be adversely affected. Together with dumping, unplanned settlements are likely to make the residents in Agbogbloshie to face increased levels of vulnerability. Although unplanned settlements were not mentioned as common by residents in Shiashie, it was highlighted by at least of the responses. One stated “A neighbour has constructed a building in the way of drainage system which has increased our vulnerability to floods.” This indicates that this is an issue in Shiashie, East Legon though to a lesser extent. Low-lying nature of relief, though mentioned by some residents in Agbogbloshie, was not among the factors reported by respondents in Shiashie, East Legon. This would imply that it perceived as a risk factor for residents in Shiashie.

Perceived vulnerability is likely to influence preparedness in response to a disaster. According to Faryabi, Nakata and Toma, (2023) individuals are likely to perform preventive behaviours if they perceive the possibility of a risk occurrence and the consequences as being severe. Thus, the level of concern that people have for their vulnerability or the likelihood of being affected by flood is likely to affect the levels of preparedness they make to the risk that is perceived. For instance, individuals residing in areas that may have blocked drainages or low altitudes such as Agbogbloshie will have a high tendency of perceiving the many hazardous effects of floods. The degree of preparedness is also determined by the socio-economic status of the respondents as has been indicated by their responses. For example, participants facing economic challenges also expressed that one cannot be ready for floods at all. Consequently, socio-economic impacts may also be stated as factors which have an influence on the community’s perception of vulnerability and preparedness towards floods.

5.3.2 Perceived Damages

When asked about the impacts of flooding, the people of Agbogbloshie said that destruction of properties and loss of lives were the most frequent impacts they endured. They also expressed concerns of diseases outbreak and low economic activities. Some others that they identified are such as damaging water/septic channels, septic systems, and soil erosion. This is in contrast with the Shiashie, East Legon residents who identified water damage on property as well as reduction in economic activities as the most noticeable impacts of flood. Some of the effects mentioned by some of the residents in Shiashie include; soil erosion, disease outbreaks, destruction of water/septic channels. The interaction of the different factors is likely to pose higher risks for residents as they create unsafe conditions. In particular, the damaged septic systems and prevalence of disease are some of the factors that lead to safety

concerns for resident living in such regions, especially in Agbogbloshie where it was the most reported.

Risk assessment was also assessed in relation to the perceived impacts of flooding in the community and participants were asked to describe the impacts. The participants in Agbogbloshie main focus and problem was on the spread of diseases and the loss of lives. There are several dangers that come with floods, these include injuries, communicable diseases and in worst case scenarios, deaths. This is validated by disease statistics where communities in Agbogbloshie are known to have frequent outbreak of waterborne disease and higher incidences compared to other regions in Accra (Abu and Codjoe, 2018). As such, perception of infectious disease as a flood risk factor would be an expectation for the region. Some respondents did express concern over the risk of soil erosion and destruction of water distribution channels and septic systems. On the other hand, most of the responses in Shiashie, East Legon highlighted destruction of properties and decreased economic productivity. However, factors such as soil erosion and destruction of water distribution channels or septic systems were not much offer concerns from the responses obtained.

5.3.3 Perceived Risk Based on Exposure

The responses highlight the contrasts between the perceived risk and vulnerability to the impacts of flooding. Due to informal settlements in poor neighbourhood, their perception and assessment of risk is based on their exposure to life-threatening experiences and effects on health (Tasantab, Gajendran and Maund, 2023). As such, the people living in poorer neighbourhoods in Agbogbloshie are more like to assess their risk to the impacts of flooding based on it impacts their life and health. This results in assessment in terms of disease outbreaks and loss of life which affects their health and livelihoods. Nevertheless, their flood risk assessment is not limited to the two factors as some of them also perceive risks in terms of property loss and decreased economic activity.

People from relatively affluent neighbourhoods may have a different assessment of risks as shown by the responses in Shiashie, East Legon. This would imply that risk assessment and perception of flooding vulnerability are influenced by the socioeconomic conditions that people live in. Nevertheless, the difference in perceived risk to their livelihoods could not be readily determined since residents in both Agbogbloshie and Shiashie, East Legon have concerns on how their work routine or businesses were affected. The impact of the economic status of individuals on flood risk assessment has been acknowledged by in other literature. Moreover, the findings can be compared to that of Mishra (2018) where despite having similar hazard, that is flooding, the two regions end up having different risk and vulnerability outcomes due to the specific factors unique to each region. However, in terms of perceived risk due to exposure, there does not seem to be much difference between the two regions.

5.4 Coping Mechanisms and Resilience

5.4.1 Coping Measures and Strategies

Residents who face vulnerability to the adverse impacts of flooding use a number strategies in attempt to cope with floods. A range of coping strategies that were mostly reported including desilting of choked gutters, climbing on top of objects, temporary migration, and help from family/friends were some of the strategies reported in Agbogbloshie. While flood adaptation measures at the household are considered as having a critical role in reducing vulnerability, their effectiveness varies depending on the specific strategy. For example, temporary migration is a coping mechanism that has also been utilised in different other regions

despite the strategy not solving the vulnerability problems that the individuals continue to face (Antwi-Agyei *et al.*, 2023). While flooding is recurrent in both Agbogbloshie and Shiashie, East Legon, how each community responds to the floods depends on their contexts. Respondents from Agbogbloshie, on the other hand only depend on community support and short-term strategies. Their coping mechanisms are more informal and reactive given their economic constraints. In both communities, however, social networks and community solidarity play a key role in building resilience. Strategies such as where community members desilt choked gutters was reported by participants in both communities. One respondent indicates “When we desilt the gutter, it helped reduce the intensity of the floods.” Residents in Agbogbloshie did report facing challenges in desilting water ways as some areas were clogged to the extent that they could not use normal tools like axes and shovels. In addition, continued waste disposal would result in areas cleared up being clogged which worsened the issue further. As such, their coping strategies were not always successful with some clogging being difficult to eliminate due to the presence of the large dumpsite (Akeso & Little, 2018).

In Shiashie, East Legon, people of the community employ both short- and long-term measures in order to cope with the problem of floods. From the interviews conducted, most families have found ways of dealing with the problem by putting up temporary barriers such as constructing raised platforms around their homes during the rainy season. Another member said that, “We first close the drainage-systems and build a small wall at the entrance of the house. It is helpful but only for some time.” While it is a short-term solution, there are indications of the use of long-term measures to mitigate the effects of floods. For example, Kayaga *et al.* (2021) in their study also pointed out that the wealthier neighbourhoods in Ghana which can access resources can easily invest in the permanent ways of combating flooding such as buying water pumps or making sure that their houses are constructed on elevated standards. Coping mechanisms employed by inhabitants of Agbogbloshie are more of reactive and are informal. For instance, some of the measures that people adopt include; putting up barriers, moving their property to other safe areas, and some of them even move out of their homes temporarily. None of the residents in Shiashie, East Legon reported some of strategies in Agbogbloshie such as climbing on top of furniture, rooftops, or trees. Agbogbloshie is a resource constrained environment and this does not allow the members to find sustainable solutions. The following statement made by one of the respondents can be quoted, “When the floods come, we have to quickly move everything.” This is an indication that the respondents are more concerned with how they can prevent the floods from causing further damage than how such floods can be prevented in the future. According to the literature, Poku-Boansi *et al.* (2020), informal settlement, such as those in Agbogbloshie, limited resources, and poor infrastructure worsen the vulnerability to flooding thus making the communities to resort to the non-formal means. Also, lack of funding from the government and the poor infrastructure systems lead to the kinds of coping strategies that are used in Agbogbloshie.

5.4.3 Building Flood Resilience

In the context of this research, flood resilience denotes the ability of a given community to recover from the impacts of a flood and regain normalcy. The key factors determining flood resilience in Shiashie, East Legon and Agbogbloshie other than economic resources include previous experience with flooding and institutional support. According to Prashar *et al.* (2023), flood resilience in urban settings results from the interplay of community-level structures and individual adaptability. This is demonstrated by how community members from both regions have built resilience to floods over a period of time through repeated experiences, community support and personal perseverance. One thing that reoccurs in the interview findings is that the residents lack institutional support. The respondents reiterated the

fact that they have gotten used to flooding incidents and have resorted to findings ways to survive without seeking external help. For instance, one participant responded, “We know no one is coming to help us, so we have to find a way to keep going.” The community members do all it takes to accommodate the floods. Instances have been highlighted in the interview findings where street vendors have to stall their businesses temporarily or relocate to areas that are less affected. For others, modifying their daily routines in order to prioritize their safety works perfectly. From the responses, it is clear that the residents suffer from a higher livelihood vulnerability index since the flooding events disrupts their businesses and works routines. As such, residents whose livelihood is negatively affected by flooding events are more likely to be more vulnerable as this also affects their income and earnings. The respondents mentioned that even though support from the local authorities and the government has been insignificant, members of the community have become self-reliant and have thus adapted to the flooding trends. This is supported by the response from an informant who stated “The community has developed a sense of resilience because they know that help won’t always come from external sources.”

5.4.4 Influence of Community and Social Networks

The findings demonstrate how crucial community and social networks have been in the preparedness and recovery from flood disasters in both Shiashie, East Legon and Agbogbloshie. Multiple respondents from Shiashie, East Legon stated that they depend on their neighbours for help when floods come. One specific response read, “When it floods, we come together as a community to unblock the drains and assist those who are badly affected.” The residents demonstrate a sense of solidarity which Behera (2023) documents as social capital. Group activities such as repair and cleaning can be used to encourage community-based programs that strengthens the society and fosters unity. In this way, communities will be in a better position to deal with flooding disaster in the future. The same can also be said of Agbogbloshie because community and social networks also play a big role in assisting the inhabitants to deal with and overcome flood-related impacts. Reflections from Agbogbloshie reveal a lot on the communal ties of the local people. This is because people in the community are usually willing to work together for each other’s benefit during and after floods. They can assist one another in carrying items and furniture and also offer homes to the families that have been affected more. As one of the participants pointed out, ‘When someone’s house is destroyed by flood, everyone contributes. It could be my house the next time’. Thaler & Seebauer (2019) noted that such a high level of social capital is important in disaster because it makes up for the lack of institutions. Similarly, according to Zaman & Raihan (2023), it takes robust social networks and adaptability for such communities to build resilience as opposed to the capacity to mitigate or prevent the disasters themselves. Besides contributing to the development of the resilience, it was found out that social capital enables the community members to exchange information, acquire resources and receive the benefits of togetherness. This therefore means that the communities that have strong ties and social networks are in a better position to combat the impacts from disasters and to be able to bounce back soon after the disasters.

5.5 Role of Institutional Factors and Governmental Support

The study reveals that there is an equally divided opinion with regard to the effectiveness of policies in managing floods in Shiashie, East Legon and Agbogbloshie. Both the communities expressed their dissatisfaction with the existing policies that are being used in flood control. The majority of the respondents interviewed noted that the policies did not produce concrete outcomes. In this regard, the study reveals that the social economic status of

Shiashie, East Legon and Agbogbloshie influences the way the people of the community view the efficiency of the policies on flood management. Some of the residents in Shiashie, East Legon noted that, there are policies in Ghana concerning waste management and urban development. However, the respondents expressed their concern on the extent of compliance of these policies and their application in flood mitigation. A respondent from Shiashie, East Legon said, “The government has done enough.” If one looks critically at this statement then there is the likelihood that the respondents have lost hope in the system and are therefore not truly content. Shiashie and Agbogbloshie on the other hand East Legon is relatively developed with good urban planning and a good governance system (Avordeh et al., 2023). Nevertheless, the community is still at high risk of flooding, which is worrisome given that even as the area has undergone development, there are still no strict adherence to waste disposal rules and well as the urban planning laws. Some respondents claim that petty traders in the community continue to dispose waste improperly causing drainage systems to clog and ultimately exacerbating the risk of adverse impacts of flooding. This aligns with the literature findings that demonstrate how urban middle-class areas tend to suffer due to the gaps between policy design and implementation (Frick-Trzebitzky et al., 2017). This, according to Twigg (2015), results in persistent environmental challenges despite the areas having proper governance structures.

Findings from Agbogbloshie contrast heavily with the ones from Shiashie, East Legon, given the large number of critical responses from the former. Agbogbloshie has a dense population, it is economically marginalized, and its urban planning is poor compared to Shiashie, East Legon (Amoako & Frimpong Boamah, 2020). This means that the challenges in flood management that the members of this community experience are even greater. Typically, the area has vast informal settlements and members of the community can hardly access basic services. Because of the low socioeconomic status, the effectiveness of policies targeting flood management in the area is severely constrained.

The respondents in Agbogbloshie also pointed out that the various policy interventions that have been made in the area to reduce the flood vulnerability have not been successful in any way. Another interview participant said that people of Agbogbloshie are ‘still vulnerable to flood issues because they are still there’ which confirms that the implemented policies failed to mitigate the risk of flooding. There have been several attempts to rezone the areas and relocate the residents in the area with no success. This has been attributed to the fact that the people living in the area are very much attached to the area and most of the people have established their livelihood in the area. This is in agreement with Silva and Kawasaki (2018) who cited that in the low-income urban areas, the combined effect of factors such as poor infrastructure, informal settlements, and weak state capability leads to higher exposure to effects of flooding. Besides that, the Agbogbloshie community cannot benefit from the formal government interventions because of the ineffective policies; that is not enough, the community has an informal status that aggravates its situations.

Governance structures and policies have therefore influenced the development of institutional frameworks that are adopted in disaster preparedness and prevention policies (Sohn et al., 2020). The observation can be made in the case of Agbogbloshie and Shiashie, East Legon although the inhabitants have different opinions about their usefulness. The Ayawaso West Municipal Assembly is the governance structure of Shiashie and for East Legon. Although, it is more developed than Agbogbloshie and has better organization, the respondents agreed that there is a discrepancy between the government’s flood control measures and their effectiveness. Respondents reported that government support is severely lacking during flood management and that they have never seen the government involve itself in managing the risk of floods. The statement made by one respondent that “they do not play a role in managing flood risks to the best of my knowledge” shows that there is a disconnection

between the actions of the local government and how the community perceives the same actions. This is partly because the government does not put in consistent effort and also because they do not enforce existing regulations fully. Urban governance literature documents this issue quite explicitly as Guddo (2024) states that it is common for a disconnect to arise between policy-making bodies and affected populations, causing suboptimal outcomes.

This is emphasized by how poor policy framework or lack of functioning local institutions are among the dynamic pressures that can interact with conditions such as low-income levels to further aggravate vulnerability of populations (Biswas & Anwaruzzaman, 2019). Therefore, the challenge in Agbogbloshie is likely worse as the area struggles with the distribution of limited resources and the complexity inherent in managing an informal and transient population. The Accra Metropolitan Assembly (AMA), which represents the community's local governance structure, faces acute challenges as respondents report poor collaboration between authorities like NADMO (National Disaster Management Organization) and the fire service. This is due to poor funding. For instance, one of the respondents said, "effective collaboration is a challenge; there is collaboration but it is not so effective." Another challenge is that the Agbogbloshie community uses informal ways of addressing the issue including arranging group meetings on their own. Hence there is an indication that the formal governance structures that have been put in place have not been satisfactory in meeting the needs of the community. This is in agreement with the study by Gaisie and Cobbinah (2023) where they reveal that in the marginalized urban areas, the weak governance structures exacerbate the residents' exposure to environmental threats since government's interventions are underfunded and ineffectively coordinated.

Another factor that may also be responsible for the difference between the two communities and also affects flood management is the lack of full participation of the members in governance processes. Those in Shiashe, East Legon said they were least involved in flood management meetings, with a majority of people claiming that they have no clue about such meetings. These findings indicate that, in Shiashe, East Legon the response to floods is not a collective one but rather an individual one. In Agbogbloshie, the respondents agreed that they have attended group meetings to discuss on how to manage flood. But these meetings were not officially facilitated and they lacked proper resources from the local government and therefore they were not very effective. One of the respondents said, "the right authorities are not helping us"; this is in regard to government interventions that are quite distant from the needs of the community. The contrast between Agbogbloshie and Shiashe, East Legon reflects the urban governance patterns elucidated by Gaisie and Cobbinah (2023) where poorer neighbourhoods are often forced to rely on informal networks and self-help strategies to manage disasters and environmental risks.

5.6 Theoretical Implications

The findings can be contextualised on the basis of the social vulnerability theory. Since the posits the impacts of social and economic variables on adverse impacts of stressors such as flooding (Blaikie et al., 2014), the findings can be used to validate or provide more information on the relationship. In particular, they provide evidence that social and economic factors can influence vulnerability of community members and act as modifying factors to their risk assessment. The findings demonstrate that people from high economic status are more likely to be well prepared and thus more resilient when it comes vulnerability to the impacts of floods. On the other hand, communities in poor neighbourhoods are likely to be disadvantaged in preparation for floods thus facing becoming more vulnerable to the adverse impacts of floods. The implications of socioeconomic status are characterised when analysing the risk assessment of vulnerability to the impacts of floods.

In terms of perceived vulnerability to flooding, communities from rich and poor neighbourhoods are likely to have different perspectives. As demonstrated by the difference between residents of Agbogbloshie and Shashie, East Legon, communities from relatively poor neighbourhoods may be influenced by the historical interactions of disease outbreaks and loss of lives. While similar factors are likely to affect those from relatively rich neighbourhoods, their perception of risks is likely to be concerned about destruction of properties and decreased economic activity. The findings also underscore the impact of coping mechanisms on resilience which in turn influences social vulnerability. Different strategies can be used to improve the capacity to withstand the adverse effects of floodings thus reducing vulnerability to the impacts of floods. Hence, the study's findings offer a demonstration of the interaction between coping mechanisms, resilience and social vulnerability. The impact of institution in the social vulnerability theory is also affirmed by the evidence showing that policies and governance structures can influence vulnerability outcomes. In particular, communities can be vulnerable to the impacts of flooding due to policies on aspects such as urban development, waste management, and overall flood management. Nevertheless, the implications of institutional factors are not clearly stratified between Agbogbloshie and Shashie, East Legon. As such, residents in both regions are likely to encounter disjointed institutional support which results in some individuals getting little or no support in dealing with the associated risks of flooding.

The findings can also be contextualised on the basis of the conceptual framework proposed in the study. The results provide clear evidence on the association between socioeconomic factors on coping strategies which validates the proposed interaction between the two factors. A relationship is also found between socioeconomic factors and risk assessment which is not accounted in the model. As such, the findings improve the conceptualised model by revealing critical areas of association that have not been captured before. Coping strategies are found to influence people's resilience to the impacts of flooding which also validates the conceptual framework on the relationship between coping strategies and flood resilience. The findings also reveal the interaction of institutions in influencing the social vulnerability of residents. In particular, factors such as urban planning, government support, and policies in place can influence vulnerability outcomes. However, this is not accounted for in the conceptualised model thus providing an opportunity to improve the model to incorporate role of institutional factors.

5.7 Practical Implications

Critical insights are gained from the findings which can have practical benefits to flood risk management and reducing vulnerability of residents in flood-prone regions. The understanding that socioeconomic factors have a significant influence on vulnerability to the impacts of floods provides an opportunity for interventions to address socioeconomic disparities that might cause certain communities to face greater levels of vulnerability (Gyekye and Darko 2022). The findings can have real-world applications to policymakers. For instance, there is need for development and implementation of clear policies that focus on the urban poor to provide targeted flood vulnerability plans that will reduce the impact of floods and improve urban resilience (Islam and Meng, 2024). It will be essential for institutions to focus on those living in informal settlement such as those in Agbogbloshie to ensure they have access to services to address disease outbreak and interventions to reduce loss of lives. The findings also act as a call for action to improve the gap between policymaking and practical experiences of individuals. Policy disconnects between policy-making bodies and affected populations tends to result in suboptimal outcomes which aggravates the vulnerability status of those living in flood-prone regions (Guddo, 2024). As evidenced by the disparity in the

perception of support between residents and municipal authorities, it will be necessary to take action and promote engagement to ensure both sides are aware of the pertinent issues and work in collaboration to addressing vulnerability to the impacts of floods.

Chapter 5 Conclusion

This study aimed at exploring the vulnerability to impacts of floods and coping mechanisms based on the inhabitants of Shiashie, East Legon and Agbogbloshie. The primary focus on socioeconomic factors that influences vulnerability would provide critical to understanding of the perception of risk, coping strategies and resilience of the residents when faced with the effects of floods. The findings reveal that there a relationship between socioeconomic status and vulnerability. Residents living in poor neighbourhoods are more vulnerable to the impacts of floods compared to those from relatively affluent neighbourhoods. The capacity to recover from floods demonstrate this as those from a higher socioeconomic status in Shiashie, East Legon are more likely to be prepared and weather the adverse effects of floods. On the other hand, due to lack of resource, low socioeconomic neighbourhoods in Agbogbloshie are unlikely to be well prepared and take longer time to recover. Social factors in both regions also influence vulnerability with individuals who have built social capital being more likely to be resilience and therefore less vulnerable compared to those who have little or no social capital. This shows the relationship between socioeconomic factors and vulnerability to the impacts of floods.

Results also indicate perception of risk varies between the region partly due to the nature of settlements and socioeconomic status. As such, the findings also underscore the role of socioeconomic factors in shaping the perception and assessment of risk. However, evaluating risk perception solely based on the exposure to the impacts of flooding did not yield much difference in the communities in both regions implying that evaluation of the risks of floodings events is not largely different. Regardless, it was clear that in response to risks faced, residents employ different coping strategies including desilting of choked gutters. Some rudimentary strategies include climbing on top of furniture, rooftops, or trees which are not necessarily successful in mitigating the vulnerability to the impacts of floods. Temporary migration also serves as another mechanism although the individuals continue to be vulnerable by returning to their flood-prone residence. Nonetheless, having access to technology that provides climate information and flood warning has proven to be effective in alleviating the adverse impacts of floods in both regions. Hence, although some coping strategies fail to address the flood risk, other can be useful in building resilience among residents which can help reduce vulnerability to adverse impacts of floods. The findings also reveal many individuals feel that there little institutional support for flood management despite the reports from the municipal council. As such, there is a perception of policy disconnect which will require engagement and collaboration with residents to ensure flood risk management policies effectively address the needs of residents in flood-prone areas.

The main recommendation from this study is the need to address socioeconomic factors as they play a significant role in shaping perception of vulnerability and risk assessment of the impacts of flooding. This will require comprehensive policies to address socioeconomic disparities that residents in deprived regions encounter. Another strategy that can be considered include development of effective intervention such as building social capital in communities to promote collaborative intervention. Technology can be an essential tool in distributing climate information and flood warnings which enable populations to take early action and reduce the potential adverse consequences of flooding. As such, institutions can leverage different technologies to effectively reach out to at-risk populations and help reduce vulnerability. There is also need for a policy framework to address the institutional gaps that are likely to be faced by residents in both Agbogbloshie and Shiashie, East Legon. Local and state government can seek to implement a policy framework that target specific area

characteristics in terms of socioeconomic and institutional factors to promote improved resilience and reduce vulnerability to the impacts of floods.

There were multiple limitations associated with the study that may have implications for the interpretation and generalizability of the findings. Future studies may seek to build upon current findings to yield more insights regarding the impact of vulnerability. First, the sample size was relatively small; such that despite being purposive, it may not be fully representative of the diverse perspectives and experiences of the people of Shiashie, East Legon and Agbogbloshie. In attempt to address this limitation, future studies can aim to utilise a larger sample size to get a more representative sample that would enable drawing credible insights and improve generalisability. Second, there is a likelihood of potential bias given the reliance on self-reported data. This is because the responses given during the interviews may have been socially desirable and may not accurately represent past experiences. Therefore, another step that researchers should consider is using empirical analysis to analyse relationships between variables to provide meaningful understanding on which variables have a causal influence on the vulnerability to the impacts of floods.

The third limitation is the focus on only two communities which can also make the study less applicable to other urban areas in the country. Researchers might consider using data from more regions to help enhance the applicability of the observation to other urban centres with communities living in flood-prone areas. Lastly, conducting the study and carrying out field observations outside the peak rainy season is likely to have limited my ability to observe the impacts of flooding at their severest point. This is because it may have affected the ability to assess the vulnerabilities in the infrastructure. Therefore, researchers might consider collecting data close to flooding events to get a better picture of the vulnerability's residents experience when the adverse effects are still fresh in their mind. Longitudinal studies may also be done to provide clearer understanding on how vulnerabilities to the impacts of floods changes overtime in relation to the factors explored in this study. Regardless of the limitations, however, the study offers insights into how the two communities have experienced flooding and provides a robust foundation for future research.

References

- Abass, K., Buor, D., Afriyie, K., Dumedah, G., Segbefi, A. Y., Guodaar, L., ... & Gyasi, R. M. (2020). Urban sprawl and green space depletion: Implications for flood incidence in Kumasi, Ghana. *International Journal of Disaster Risk Reduction*, 51, 101915.
- Abass, K., Dumedah, G., Frempong, F., Muntaka, A. S., Appiah, D. O., Garsonu, E. K., & Gyasi, R. M. (2022). Rising incidence and risks of floods in urban Ghana: Is climate change to blame? *Cities*, 121, 103495.
- Aboagye, D. A. (2008). *Living on the edge: Analysis of flooding risk and human vulnerability in the Accra Metropolitan Area, Ghana*. The University of Oklahoma.
- Aboagye, D. C. (2012). Living with familiar hazards: Flood experiences and human vulnerability in Accra, Ghana. *Articulo – Journal of Urban Research Briefings*, 48(12), n/a–n/a. doi:10.1029/2012WR012335
- Abu, M., & Codjoe, S. N. A. (2018). Experience and future perceived risk of floods and diarrheal disease in urban poor communities in Accra, Ghana. *International Journal of Environmental Research and Public Health*, 15(12), 2830.
- Abunyewah, M., Erdiaw-Kwasie, M. O., Okyere, S. A., Thayaparan, G., Byrne, M., Lassa, J., Zander, K. K., Fatemi, M. N. & Maund, K. (2023). 'Influence of personal and collective social capital on flood preparedness and community resilience: Evidence from Old Fadama, Ghana', *International journal of disaster risk reduction*. Elsevier, 94, p. 103790.
- Adger, W. N. (2006). Vulnerability. *Global Environmental Change*, 16(3), 268–281.
- Adjei-Darko, P. (2017). Remote sensing and geographic information systems for flood risk mapping and near real-time flooding extent assessment in the greater Accra metropolitan area.
- Afeku, K. (2005). *Urbanization and flooding in Accra, Ghana* (Master's thesis, Miami University).
- Africa Climate Mobility Initiative. (2024). *Floods*. Retrieved August 1, 2024, from <https://africa.climate-mobility.org/explore-the-data/floods>
- Akese, G. A., & Little, P. C. (2018). Electronic waste and the environmental justice challenge in Agbogbloshie. *Environmental Justice*, 11(2), 77-83.
- Akese, G. A. (2019). *Electronic waste (e-waste) science and advocacy at Agbogbloshie: the making and effects of "The world's largest e-waste dump"* (Doctoral dissertation, Memorial University of Newfoundland).
- Almoradie, A., de Brito, M. M., Evers, M., Bossa, A., Lumor, M., Norman, C., Yacouba, Y. & Hounkpe, J. (2020). 'Current flood risk management practices in Ghana: Gaps and opportunities for improving resilience', *Journal of Flood Risk Management*. Wiley Online Library, 13(4), p. e12664.
- Amato, A. *et al.* (2019) 'Disaster waste management after flood events', *Journal of Flood Risk Management* [Preprint]. doi: <https://doi.org/10.1111/jfr3.12566>.
- Amoako, C. (2018). Emerging grassroots resilience and flood responses in informal settlements in Accra, Ghana. *GeoJournal*, 83, 949-965.
- Amoako, C. & Frimpong Boamah, E. (2014) 'The three-dimensional causes of flooding in Accra, Ghana', *International Journal of Urban Sustainable Development*, 7(1), pp. 109–129.
- Amoako, C., & Frimpong Boamah, E. (2020). Becoming vulnerable to flooding: An urban assemblage view of flooding in an African city. *Planning Theory & Practice*, 21(3), 371-391.
- Amoako, C., & Inkoom, D. K. B. (2018). The production of flood vulnerability in Accra, Ghana: Re-thinking flooding and informal urbanisation. *Urban Studies*, 55(13), 2903-2922.

- Antwi-Agyei, P., Baffour-Ata, F., Koomson, S., Kyeretwie, N. K., Nti, N. B., Owusu, A. O., & Razak, F. A. (2023). Drivers and coping mechanisms for floods: experiences of residents in urban Kumasi, Ghana. *Natural Hazards*, 116(2), 2477-2500.
- Arnell, N. W., & Lloyd-Hughes, B. (2014). The global-scale impacts of climate change on water resources and flooding under new climate and socio-economic scenarios. *Climatic change*, 122, 127-140.
- Arsel, M. (2023). Climate change and class conflict in the Anthropocene: sink or swim together? *The Journal of Peasant Studies*, 50(1), 67-95.
- Asare, G., & Tuffour, M. (2024). Urban flooding: Coping with Weiya Dam spillage by downstream communities in Ghana. *Jàmbá-Journal of Disaster Risk Studies*, 16(1), 1476.
- Atakorah, G. B., Owusu, A. B., & Adu-Boahen, K. (2023). Geophysical assessment of flood vulnerability of Accra Metropolitan Area, Ghana. *Environmental and Sustainability Indicators*, 19, 100286.
- Avordeh, T. K., Gyamfi, S., Opoku, A. A., & Peprah, F. (2023). Assessing the viability and environmental impact of residential demand response programs: A case study in Shishie, East Legon, Greater Accra, Ghana. *Energy Reports*, 10, 4604-4615.
- Aziz, T. (2018). Myth and reality of vulnerability to disaster: Pressure and release model for hazards in Bangladesh. *Journal of South Asian Studies*, 6(1), 23-31.
- Balström, T., Hasholt, B., Allotey, A. N., & Gyekye, P. M. (2024). The Identification of Flood-Prone Areas in Accra, Ghana Using a Hydrological Screening Method. *GeoHazards*, 5(3), 755-779.
- Bankoff, G., Georg Frerks and Hilhorst, D. (2004) *Mapping vulnerability: disasters, development, and people*. London: Earthscan.
- Bankoff, G., Frerks, G., & Hilhorst, D. (2013). *Mapping vulnerability: Disasters, development and people*. Routledge.
- Behera, J. K. (2023). Role of social capital in disaster risk management: a theoretical perspective in special reference to Odisha, India. *International Journal of Environmental Science and Technology*, 20(3), 3385-3394.
- Benito, I., Aerts, J. C., Eilander, D., Ward, P. J., & Muis, S. (2024). Stochastic coastal flood risk modelling for the east coast of Africa. *npj Natural Hazards*, 1(1), 10.
- Biswas, R., & Anwaruzzaman, A. K. M. (2019). Measuring hazard vulnerability by bank erosion of the Ganga river in Malda district using PAR model. *Journal of Geography, Environment and Earth Science International*, 22(1), 1-15.
- Biswas, S. & Nautiyal, S. (2023). 'A review of socio-economic vulnerability: The emergence of its theoretical concepts, models and methodologies', *Natural Hazards Research*. Elsevier.
- Blaikie, P., Cannon, T., Davis, I. & Wisner, B. (2014). *At risk: natural hazards, people's vulnerability and disasters*. Routledge.
- Botzen, W. J. W., Aerts, J., & van den Bergh, J. C. J. M. (2009). Dependence of flood risk perceptions on socioeconomic and objective risk factors. *Water Resources Research*, 45(10).
- Brempong, E. K., Almar, R., Angnuureng, D. B., Mattah, P. A. D., Jayson-Quashigah, P. N., Antwi-Agyakwa, K. T., & Charuka, B. (2023). Coastal flooding caused by extreme coastal water level at the world heritage historic Keta City (Ghana, West Africa). *Journal of Marine Science and Engineering*, 11(6), 1144.
- Brooks, N., & Adger, W. N. (2005). Assessing and enhancing adaptive capacity. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*, 165-181.
- Caloia, F. G., Ginkel, K. van, & Jansen, D.-J. (2023). *Floods and financial stability: Scenario-based evidence from below sea level* (796).

- Carter, J. G., Cavan, G., Connelly, A., Guy, S., Handley, J. & Kazmierczak, A. (2015). 'Climate change and the city: Building capacity for urban adaptation', *Progress in planning*, Elsevier, 95, pp. 1–66.
- Castellanos, et al. (2022). The people of Agbogbloshie: An epilogue for a place that no longer exists. Available at <https://www.meer.com/en/70108-the-people-of-agbogbloshie>
- Cerulli, D., Scott, M., Aunap, R., Kull, A., Pärn, J., Holbrook, J., & Mander, Ü. (2020). The role of education in increasing awareness and reducing impact of natural hazards. *Sustainability*, 12(18), 7623.
- Charisna, N., Hamidah & Adib, M. (2018). 'Coping Strategies for the Flood Disaster Practiced by the Pekauman Community in Sidoarjo Regency', *Proceedings of the 2nd International Conference Postgraduate School*, 1, pp. 834–838.
- Christian, A. K., Dovie, B. D., Akpalu, W., & Codjoe, S. N. A. (2021). Households' socio-demographic characteristics perceived and underestimated vulnerability to floods and related risk reduction in Ghana. *Urban Climate*, 35, 100759.
- Cobbinah, P. B., & Poku-Boansi, M. (2018). Towards resilient cities in Ghana: insights and strategies. *Futures*, 101, 55–66.
- Codjoe, S. N. A., Owusu, G., & Burkett, V. (2014). Perception, experience, and indigenous knowledge of climate change and variability: The case of Accra, a sub-Saharan African city. *Regional environmental change*, 14, 369–383.
- Collins, T. W. (2009). The production of unequal risk in hazardscapes: An explanatory frame applied to disaster at the US–Mexico border. *Geoforum*, 40(4), 589–601.
- Crowley, J. (2021). 'Social vulnerability factors and reported post-disaster needs in the aftermath of hurricane florence', *International Journal of Disaster Risk Science*. Springer, 12(1), pp. 13–23.
- Dangol, N. (2024). Shaping the perception of flood risk among residents of riverbank informal settlements in Kathmandu. *International Journal of Disaster Risk Reduction*, 105, 104423.
- Daksiya, V., Mandapaka, P. V., & Lo, E. Y. (2021). Effect of climate change and urbanisation on flood protection decision-making. *Journal of Flood Risk Management*, 14(1), e12681.
- Dekongmen, B. W., Kabo-bah, A. T., Domfeh, M. K., Sunkari, E. D., Dile, Y. T., Antwi, E. O., & Gyimah, R. A. A. (2021). Flood vulnerability assessment in the Accra Metropolis, south-eastern Ghana. *Applied Water Science*, 11, 1–10.
- De Silva, M., & Kawasaki, A. (2018). Socioeconomic vulnerability to disaster risk: a case study of flood and drought impact in a rural Sri Lankan community. *Ecological Economics*, 152, 131–140.
- Douglas, I. et al. (2008) 'Unjust waters: climate change, flooding and the urban poor in Africa', *Environment and Urbanization*, 20(1), pp. 187–205.
- Elmhirst, R., Middleton, C., & Resurrección, B. P. (2017). Migration and floods in Southeast Asia: A mobile political ecology of vulnerability, resilience and social justice. In *Living with floods in a mobile Southeast Asia* (pp. 1–21). Routledge.
- Etwire, P. M., Al-Hassan, R. M., Kuwornu, J. K. M., & Osei-Owusu, Y. (2013). Application of livelihood vulnerability index in assessing vulnerability to climate change and variability in Northern Ghana. *Journal of Environment and Earth Science*, 3(2), 157–170.
- Faryabi, R., Rezabeigi Davarani, F., Daneshi, S., & Moran, D. P. (2023). Investigating the effectiveness of protection motivation theory in predicting behaviors relating to natural disasters, in the households of southern Iran. *Frontiers in Public Health*, 11, 1201195.
- Fothergill, A., & Peek, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. *Natural hazards*, 32, 89–110.
- Fothergill, A., & Peek, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. *Natural hazards*, 32, 89–110.

- Frick-Trzebitzky, F., & Bruns, A. (2019). Disparities in the implementation gap: adaptation to flood risk in the Densu Delta, Accra, Ghana. *Journal of Environmental Policy & Planning*, 21(5), 577-592.
- Frick-Trzebitzky, F., Baghel, R., & Bruns, A. (2017). Institutional bricolage and the production of vulnerability to floods in an urbanising delta in Accra. *International Journal of Disaster Risk Reduction*, 26, 57-68.
- Gaisie, E., & Cobbinah, P. B. (2023). Planning for context-based climate adaptation: Flood management inquiry in Accra. *Environmental Science & Policy*, 141, 97-108.
- Guddo, Dr. (2024). Conceptualization of Flooding Disaster: A Theoretical Perspective of Management. *Disaster Advances*. 17. 40-45. 10.25303/172da040045.
- Gyekye, K. A. & Darko, P. K. (2022). 'Assessing Community Coping Strategies in Sustainable Flood Management. A Case Study of Kaemibre and Walantu in Kasoa', *Ghana Journal of Geography*, 14(3), pp. 211–251.
- Ha, K.-M. (2015). 'The role of religious beliefs and institutions in disaster management: A case study', *Religions*. MDPI, 6(4), pp. 1314–1329.
- Hallegatte, S., Vogt-Schilb, A., Bangalore, M. & Rozenberg, J. (2016). *Unbreakable: building the resilience of the poor in the face of natural disasters*. World Bank Publications.
- Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Bangalore, M., & Beaudet, C. (2020). From poverty to disaster and back: A review of the literature. *Economics of Disasters and Climate Change*, 4, 223-247.
- Hewitt, C., Mason, S. & Walland, D. (2012). 'The global framework for climate services', *Nature Climate Change*. Nature Publishing Group UK London, 2(12), pp. 831–832.
- Houston, D., Werritty, A., Ball, T., & Black, A. (2021). Environmental vulnerability and resilience: Social differentiation in short-and long-term flood impacts. *Transactions of the Institute of British Geographers*, 46(1), 102–119.
- International Panel on Climate Change. (2007). *Climate Change 2007: Impacts, Adaptation, and Vulnerability*. <https://www.ipcc.ch/report/ar4/wg2/>
- Islam, M. T., & Meng, Q. (2024). Spatial analysis of socio-economic and demographic factors influencing urban flood vulnerability. *Journal of Urban Management*.
- Jha, A. *et al.* (2011) 'Five feet high and rising: cities and flooding in the 21st century', *RePEc: Research Papers in Economics* [Preprint].
- Karley, N. K. (2009). Flooding and physical planning in urban areas in West Africa: Situational analysis of Accra, Ghana. *Theoretical and Empirical Researches in Urban Management*, 4(4 (13), 25-41.
- Kayaga, S. M., Amankwaa, E. F., Gough, K. V, Wilby, R. L., Abarike, M. A., Codjoe, S. N. A., Kasei, R., Nabilse, C. K., Yankson, P. W. K., & Mensah, P. (2021). Cities and extreme weather events: impacts of flooding and extreme heat on water and electricity services in Ghana. *Environment and Urbanization*, 33(1), 131–150.
- Kyne, D., & Aldrich, D. P. (2020). Capturing bonding, bridging, and linking social capital through publicly available data. *Risk, Hazards & Crisis in Public Policy*, 11(1), 61–86.
- Lan, H., Zhao, Z., Li, L., Li, J., Fu, B., Tian, N., ... & Clague, J. J. (2024). Climate change drives flooding risk increases in the Yellow River Basin. *Geography and Sustainability*, 5(2), 193-199.
- Lazarus, R. S. & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer publishing company.
- Mabon, L. (2020). 'Making climate information services accessible to communities: What can we learn from environmental risk communication research?', *Urban climate*. Elsevier, 31, p. 100537.
- McDermott, T. K. J. (2022). Global exposure to flood risk and poverty. *Nature Communications*, 13(1), 3529.

- Merz, B., Blöschl, G., Vorogushyn, S., Dottori, F., Aerts, J. C., Bates, P., ... & Macdonald, E. (2021). Causes, impacts and patterns of disastrous river floods. *Nature Reviews Earth & Environment*, 2(9), 592-609.
- Mind'je, R., Li, L., Amanambu, A. C., Nahayo, L., Nsengiyumva, J. B., Gasirabo, A. & Mindje, M. (2019). 'Flood susceptibility modeling and hazard perception in Rwanda', *International journal of disaster risk reduction*. Elsevier, 38, p. 101211.
- Mishra, K. (2018). Geomorphological studies and flood risk assessment of Kosi River basin using remote sensing and GIS techniques, p 57. Indian Institute of Remote Sensing, Indian Space Organization, Dehradun – 248 001 India, 2013.
- Møller-Jensen, M., Agergaard, J., Andreasen, M. H., Oteng-Ababio, M., & Yankson, P. (2020). Urban expansion and consolidation in Accra's peripheries. *Department of Geosciences and Natural Resource Management, University of Copenhagen, Frederiksberg. Number of, 109.*
- Mondal, M. S. H., Murayama, T. & Nishikizawa, S. (2020). 'Determinants of household-level coping strategies and recoveries from riverine flood disasters: empirical evidence from the Right Bank of Teesta River, Bangladesh', *Climate*. MDPI, 9(1), p. 4.
- Munyai, R. B., Nethengwe, N. S. & Musyoki, A. (2019). 'An assessment of flood vulnerability and adaptation: A case study of Hamutsha-Muungamunwe village, Makhado municipality', *Jàmbá: Journal of Disaster Risk Studies*. AOSIS, 11(2), pp. 1–8.
- Mutenje, M. J. (2021). 'Assessment of the evidence base on adaptation benefits of CSA options across timescales and geographies in West Africa'. CGIAR Research Program on Climate Change, Agriculture and Food Security.
- Nka, B. N., Oudin, L., Karambiri, H., Paturel, J. E., & Ribstein, P. (2015). Trends in floods in West Africa: Analysis based on 11 catchments in the region. *Hydrology and Earth System Sciences*, 19(11), 4707-4719.
- Nyarko, B. K. (2014). Application of a rational model in GIS for flood risk assessment in Accra, Ghana.
- O'Shea, D., Nathan, R., Wasko, C., Ho, M., & Sharma, A. (2024). Evaluation of key flood risk drivers under climate change using a bottom-up approach. *Journal of Hydrology*, 131694.
- Ogie, R., Castilla Rho, J., Clarke, R. J., & Moore, A. (2018, October). Disaster risk communication in culturally and linguistically diverse communities: the role of technology. In *Proceedings* (Vol. 2, No. 19, p. 1256). MDPI.
- Okeleye, S. O., Olorunfemi, F. B., Sogbedji, J. M. & Aziadekey, M. (2016). 'Impact assessment of flood disaster on livelihoods of farmers in selected farming communities in Oke-Ogun region of Oyo state, Nigeria', *International Journal of Scientific and Engineering Research*, 7(8), pp. 2067–2083.
- Osberghaus, D. (2021). 'Poorly adapted but nothing to lose? A study on the flood risk–income relationship with a focus on low-income households', *Climate Risk Management*. Elsevier, 31, p. 100268.
- Owusu-Ansah, J. K., Dery, J. M., & Amoako, C. (2019). Flood vulnerability and coping mechanisms around the Weija Dam near Accra, Ghana. *GeoJournal*, 84(6), 1597-1615.
- Owusu, M., & Nursey-Bray, M. (2019). Socio-economic and institutional drivers of vulnerability to climate change in urban slums: The case of Accra, Ghana. *Climate and Development*, 11(8), 687-698.
- Panayotis, P., Kortenhaus, A., SwerpeL, B., & Jiménez, J. A. (2008). Review of Flood Hazard Mapping. *FLOODsite Consortium, Spain*.
- Paul, S. K., & Routray, J. K. (2010). Flood proneness and coping strategies: the experiences of two villages in Bangladesh. *Disasters*, 34(2), 489–508.

- Poku-Boansi, M., Amoako, C., Owusu-Ansah, J. K., & Cobbinah, P. B. (2020). What the state does but fails: Exploring smart options for urban flood risk management in informal Accra, Ghana. *City and Environment Interactions*, 5, 100038.
- Prall, M. C., Brandt, U. S., Halvorsen, N. S., Hansen, M. U., Dahlberg, N., & Andersen, K. J. (2024). A comprehensive approach for assessing social flood vulnerability and social flood risk: The case of Denmark. *International Journal of Disaster Risk Reduction*, 111, 104686.
- Prashar, N., Lakra, H. S., Shaw, R., & Kaur, H. (2023). Urban Flood Resilience: A comprehensive review of assessment methods, tools, and techniques to manage disaster. *Progress in Disaster Science*, 100299.
- Pulwarty, R. S., & Riebsame, W. E. (1997). The political ecology of vulnerability to hurricane-related hazards. In *Hurricanes: Climate and socioeconomic impacts* (pp. 185-214). Berlin, Heidelberg: Springer Berlin Heidelberg.
- Rain, D. et al. (2011) *Accra Ghana: A City Vulnerable to Flooding and Drought-Induced Migration Case study prepared for Cities and Climate Change: Global Report on Human*
- Rana, I. A., Jamshed, A., Younas, Z. I., & Bhatti, S. S. (2020). Characterizing flood risk perception in urban communities of Pakistan. *International Journal of Disaster Risk Reduction*, 46, 101624.
- Reed, M. S., Podesta, G., Fazey, I., Geeson, N., Hessel, R., Hubacek, K., Letson, D., Nainggolan, D., Prell, C., & Rickenbach, M. G. (2013). Combining analytical frameworks to assess livelihood vulnerability to climate change and analyse adaptation options. *Ecological Economics*, 94, 66–77.
- Relief Web International . (2022). *The interplay of drought-flood extreme events in Africa over the last twenty years (2002-2021)*. Centre for Research on the Epidemiology of Disasters.
- Rentschler, J., Salhab, M., & Jafino, B. A. (2022). Flood exposure and poverty in 188 countries. *Nature communications*, 13(1), 3527.
- Safiah Yusmah, M. Y., Bracken, L. J., Sahdan, Z., Norhaslina, H., Melasutra, M. D., Ghaffarianhoseini, A., Sumiliana, S. & Shereen Farisha, A. S. (2020). ‘Understanding urban flood vulnerability and resilience: a case study of Kuantan, Pahang, Malaysia’, *Natural Hazards*. Springer, 101, pp. 551–571.
- Sanyal, J., & Lu, X. X. (2005). Remote sensing and GIS-based flood vulnerability assessment of human settlements: a case study of Gangetic West Bengal, India. *Hydrological Processes: An International Journal*, 19(18), 3699-3716.
- Savari, M., Jafari, A. & Sheheytavi, A. (2024). ‘The impact of social capital to improve rural households’ resilience against flooding: evidence from Iran’, *Frontiers in Water*. Frontiers Media SA, 6, p. 1393226.
- Settlements 2011. Available at: http://ipc.sdsu.edu/wp-content/uploads/2019/03/Rain_etal_Ch4.pdf (Accessed: 14 June 2024).
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), 282–292.
- Sohn, W., Brody, S. D., Kim, J.-H. & Li, M.-H. (2020). ‘How effective are drainage systems in mitigating flood losses?’, *Cities*. Elsevier, 107, p. 102917.
- Sun, L., Liu, X. & Yang, Y. (2022). ‘Source of fatalistic seismic belief: The role of previous earthquake experience and general fatalism’, *International Journal of Disaster Risk Reduction*. Elsevier, 83, p. 103377.
- Tasantab, C. J., Gajendran, T., & Maund, K. (2023). How the past influences the future: flood risk perception in informal settlements. *Environmental Hazards*, 22(3), 201–220.
- Thaler, T., & Seebauer, S. (2019). Bottom-up citizen initiatives in natural hazard management: Why they appear and what they can do? *Environmental Science & Policy*, 94, 101–111.
- Thomas D.S.K., Phillips B.D., Lovekamp W.E. & Fothergill A., (2013). Social Vulnerability to Disasters, 2nd ed., CRC Press, Boca Raton, FL.

- Twigg, J. (2015) Disaster Risk Reduction. Available at <https://humanitarianlibrary.org/sites/default/files/2023/10/GPR-9-web-string-1.pdf>
- Twumasi, Y.A. & R. Asomani-Boateng. (2003). 'Mapping seasonal hazards for flood management in Accra, Ghana using GIS'. doi: <https://doi.org/10.1109/igarss.2002.1026807>.
- Uwayisenga, A. J., Adelekan, I. & Oguge, N. (2024). 'Assessment of impacts of flood and coping strategies among rural households in Gicumbi district, Rwanda', *Environmental Research Communications*. IOP Publishing, 6(5), p. 55019.
- Wang, X., & Cheng, Z. (2020). Cross-sectional studies: strengths, weaknesses, and recommendations. *Chest*, 158(1), S65-S71.
- Yankson, P. W. K., Owusu, A. B., Owusu, G., Boakye-Danquah, J., & Tetteh, J. D. (2017). Assessment of coastal communities' vulnerability to floods using indicator-based approach: a case study of Greater Accra Metropolitan Area, Ghana. *Natural hazards*, 89, 661-689.
- Yoon, D. K. (2012). Assessment of social vulnerability to natural disasters: a comparative study. *Natural hazards*, 63, 823-843.
- Zaman, M. O., & Raihan, M. M. H. (2023). Community resilience to natural disasters: A systemic review of contemporary methods and theories. *Natural Hazards Research*, 3(3), 583–594.