ADAPTATION TO URBAN FLOODS AMONG THE POOR IN THE ACCRA METROPOLITAN AREA

BY

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Declaration

I, **Emmanuel Anyang Abeka**, hereby declare that except for reference to other people's work which has been duly acknowledged, this thesis is the result of my own research carried out at the Institute of Statistical, Social and Economic Research (ISSER), University of Ghana under the supervision of Professor Felix A. Asante (Institute of Statistical, Social and Economic Research), Professor Samuel Nii Codjoe (Regional Institute of Population Studies, University of Ghana) and Dr. Wolfram Laube (Centre for Development Studies, University of Bonn, Germany). This thesis has neither in whole nor in part been presented for another degree.

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Dedication

I dedicate this work to my wife and children, Eunice, Briana and Manuel Abeka

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To God be the glory

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Abstract

Urbanisation and climate change are likely to induce more floods in African cities. Nonetheless, studies on public and private adaptation to floods that centre on the urban poor in Africa are scanty. Studies in this area largely reflect the structuralist conception of adaptation. This study departs from this top-down approach as it explores household and public adaptation to urban floods among the poor in Accra from an actor-oriented perspective. Specifically, the study objectives are to: a) analyse the causes of flooding in poor urban communities in Accra from various actor perspectives; b) understand the actions and challenges of actors involved in flood adaptation; and c) determine the correlates of household flood risk and private proactive adaptation choices among the poor in Accra.

The study applied both exploratory and cross-sectional designs. Data collection methods under the exploratory design were literature review, in-depth interviews with key informants and focus group discussions in three communities, namely, Glefe, Mpoase and Agbogbloshie. A mini workshop for stakeholders in flood adaptation in Accra was organised to brainstorm on challenges within the network of actors. The study employed Kendall's Co-efficient of Concordance, network maps and content analyses of in-depth interviews as well as focus group discussions to achieve the first and second objectives. The cross-sectional aspect of the study involved structured interviews with 330 households selected through multi-stage sampling and using logistic and ordered probability regressions to analyse the results of the household survey to achieve objective three.

The study found out that the level agreement on the perceived causes of flooding among actors involved flood adaptation in Accra was rather low. The differences in opinion were influenced by externalisation of blame and responsibility among actors as well as different actor interests. The challenges to public adaptation to urban floods in Accra are legal pluralism, strict adherence to organisational goals among formal institutions involved in flood adaptation and poor integration of local knowledge into formal flood abatement systems. There is also mistrust between local communities and the metropolitan level actors.

At the household level, the predictors of flood adaptation choices were tenancy status, home elevation, type of wall material, perceptions about future occurrence of floods, perceived adaptation cost, perceived adaptation efficacy and availability of bonding social capital. The study also found out that taking precautionary measures ahead of floods and living in sandcrete houses away from water bodies and at high elevations reduced household susceptibility to property damage or loss from urban floods.

The study recommends streamlining power relations among institutions involved in flood adaptation and integrating informal actors into the formal flood adaptation structures at the metropolitan level. Awareness creation programmes should focus on zoning regulations, future occurrence of floods and construction materials/methods in flood zones. Finally, in-situ community upgrading, flood zone planning and enforcement of zoning regulations is also recommended to minimise exposure to flood risk in the study communities.

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List of Abbreviations/Acronyms

ACOPS	Advisory Committee on the Protection of the Sea
AESC	Architectural and Engineering Services Corporation
AfD	Agencies Francis de Developpment
AMA	Accra Metropolitan Area
CDO	Civil Defence Organization
CDR	Crude Death Rate
CEPL	Centre for Public Law
COHRE	Centre on Hosing Rights and Evictions
Dept.	Department
Dev’t.	Development
DUR	Department of Urban Roads
DROP	Disaster Resilience of Place
ENSO	El Nino Southern Oscillation
EPA	Environmental Protection Agency
GAMA	Greater Accra Metropolitan Area
GFDRR	Global Facility for Disaster Risk Reduction and Recovery
GHAFUP	Ghana Federation for the Urban Poor
GIS	Geographic Information System
GPS	Global Positioning System
G-MET	Ghana Meteorological Agency
ILGS	Institute of Local Government Studies
IWMI	International Water Management Institute
IPCC	Intergovernmental Panel on Climate Change
KLERP	Korle Lagoon Ecological Restoration Project
L.I.	Legal Instrument
Maint.	Maintenance
Metro.	Metropolitan
Min.	Ministry
MLGRD	Ministry of Local Government and Rural Development
MPPACC	Model for Private Proactive Adaptation to Climate Change
MWRWH	Ministry of Water Resources, Works and Housing

NADMO	National Disaster Management Organization
NDC	National Democratic Congress
NDPC	National Development Planning Commission
NEDECO	Netherlands Engineering Consultants
NPP	New Patriotic Party
NRC	National Redemption Council
OCHA	Office for the Coordination of Humanitarian Affairs
OECD	Organisation for Economic Cooperation and Development
OPEC	Organisation of Petroleum Exporting Countries
PAMSCAD	Programme for Mitigating the Social Cost of Adjustment
SSNIT	Social Security and National Insurance Trust
TCPD	Town and Country Planning Department
UN	United Nations
UNDRO	United Nations Disaster Relief Organization
UESP	Urban Environmental Sanitation Project
UNEP	United Nations Environment Programme
UNPF	United Nations Population Fund
UN-HABITAT	United Nations Human Settlement Programme
WHO	World Health Organisation
WRC	Water Resources Commission

List of Legislations

Act 125	State Lands Act, 1962
Act 29	Criminal Codes, 1960
Act 462	Local Government Act, 1993
Act 490	Environmental Protection Agency Act, 1996
Act 517	National Disaster Management Organisation Act, 1996
Act 525	Ghana Health Service and Teaching Hospital Act, 1996
Act 552	Water Resources Commission Act, 1996
Act 682	Ghana Meteorological Service Act, 2004
Act 1908	Infectious Disease Act, 1908
CAP 84	Town and Country Planning Act, 1945
L.I. 1625	Environmental Impact Assessment Regulation, 1996
L.I.1630	National Building Code
L.I. 1702	Environmental Impact Assessment (Amendment) Regulations, 2002
L.I.1692	National Water Resources Regulations, 2001

CHAPTER ONE

INTRODUCTION

1.1 Background

Floods and tropical cyclones accounted for 40% of the reported 1,028 major disasters worldwide between 2004 and 2008 (Costello et al. 2009). More worrisome is the observed rising trend in global reports of flooding. Reports of major hydro-meteorological natural catastrophes have more than tripled since the 1950s, increasing from less than two (2) per year to more than six (6) per year in 2007 (Munich Reinsurance, 2008). Africa has also seen rising fatalities and displacement directly attributable to flooding. Fatalities from Africa's floods increased from less than 20,000 between 1950-1969 to almost 160,000 between 1990 and 2009 (Di Baldassarre et al. 2010). In addition, 2.5 million persons were displaced because of flood on the continent in the year 2007 (Tschakert et al. 2010). Climate change/variability are likely to exacerbate flooding in Africa as several studies have associated the phenomenon with rising intensity and frequency of floods in Africa (Seneviratne et al. 2012; Sakijege et al. 2012; Costello et al. 2009; Few et al. 2004; McCarthy et al. 2001). Urbanisation, through increasing the extent of impervious surfaces, changing land uses and hydrology, will also induce conditions that accentuate flood risk in urban areas (Rain et al. 2011; Andjelkovic, 2001).

Urbanisation is a worldwide phenomenon. Before the year 1800, less than 5% of the world's population lived in urban areas. The figure increased to 47% in 2001. A little over 50% of the world's population (6.6 billion) live in urban areas today (UNPF, 2007). This is likely to rise to almost 60% by 2030 (OECD, 2008). Even as one of the least urbanized continents of the world, Africa will see its share of urban population increase from 39.6% in 2011 to 57.7% by 2050 (United Nations Department of Economic and Social Affairs, 2012). In Ghana, the urban population increased from 23.1% in 1960 to 31.3% and 43.3% in 1984 and 2000 respectively (Ghana Statistical Service, 2002). In 2010, the urban population accounted for more than half (50.9%) of the total population of Ghana (Yeboah et al. 2013). This trend notwithstanding, Yeboah et al. (2013) have shown that growth in Ghana's most urbanised region, the Greater Accra Metropolitan Area (GAMA), is declining after peaking between 1984 and 2000.

Urbanization has been associated with urban poverty in Sub-Saharan Africa. Presently, a third of the world's urbanites live in slums, the proportion increases to seven out of ten (72%) on the African continent and three out of four (75%) in sub Saharan Africa (UN-Habitat, 2008; UN-Habitat 2006; Cohen 2004). In Ghana an estimated 5 million persons were living in slums in 2001 and the slum population was growing at a rate of 1.8% per annum (NDPC, 2005). Most of the poor in developing country cities live in sub-standard housing in hazardous areas prone to flooding and other natural disasters (Fatti and Patel, 2013; Braun and Aßheuer, 2011; Jabeen et al. 2010; Songsore et al. 2009; Yankson and Owusu, 2007).

As urbanisation, urban poverty and climate change/variability have been associated with flooding in Africa, proactive planned adaptation is necessary to reduce vulnerability among the urban poor in African cities. This notwithstanding, household decision-making processes on flood adaptation among the urban poor is yet to be explored in the African context and studies that investigate actor perceptions on how flood risk unfolds in the urban setting and the role of knowledge domains and power relations in public adaptation remain few (Fatti and Patel, 2013; Koch et al. 2007). Nonetheless, studies of such nature are a necessary step towards improving adaptation on the African Continent under the expectation of climate change.

1.2 Problem Statement

Flooding is a serious environmental challenge in Accra (Rain et al. 2011). About 25% of the population of Accra live in flood plains or areas liable to flood (Karley, 2009). Flooding is not limited to blighted communities in the Accra Metropolitan Area, but households living in these communities bear the brunt of flooding after moderate to heavy rainfall (Aboagye, 2008). A recent study by Codjoe et al. (2014) in three low-income communities in Accra ranked flooding high among the existing livelihood stressors. Rain et al. (2011) using enumeration areas in the catchment of the Odaw River in Accra also conclude that of the 172,000 households at risk from 10 year return floods, 33,000 (19.4%) lived in enumeration areas with the highest slum indices. Rain and his colleagues further predicted an increase in the proportion of poor urbanities susceptible to urban flood as their study concluded that 60,000 (33.3%) of the 200,000 at risk population in the next ten years will be living in the worst slums.

The impact of floods involves loss of human life and property as well as displacement of households (see Plate 1.1 to 1.4 for some adverse consequences of flooding in the study communities). In the October 2011 flood in Accra, for example, 14 people lost their life and 17,000 people were displaced (UNEP/OCHA, 2011). In Alajo, a high-density low income locality within the flood plain of the Odaw River in Accra, a study revealed progressive increases in flood damages as 56%, 61% and 72% of the households surveyed suffered severe damage to their houses in the 1995, 2001 and 2007 floods (Aboagye, 2008). Apart from damage to housing, flooding in low income neighbourhoods also leads to property losses. In three low income communities in Accra the present value of properties lost in forty five (45) households after the October 2011 flood was estimated at GH¢150,000.00[1] (ILGS and IWMI, 2011).

Plate 1.1: Vehicle Inundated by Flood – Mpoase

Plate 1.2: Flooding of Rooms –Glefe

Plate 1.3: Migrating from Floods-Agbogbloshie

Plate 1.4: Building Destroyed by Storm Surge-Glefe

Source: Author's Field Work, June 2014

Some households in poor flood prone communities adopt various strategies as protective measures against floods whereas others do not take any precautionary action ahead of floods. Aboagye (2012a) reports that as many as 59% and 47% of the

[1] GH₵1=US$ 0.60994 as at 31st December, 2011

households in Alajo did not undertake any structural measures prior to the 1995 and 2007 floods in Accra respectively. This is against the background that public flood adaptation measures hardly cover these communities.

Public institutions like the Hydrological Services Department of the Ministry of Water Resources, Works and Housing and the Town and Country Planning Department of the various assemblies are in charge of various aspects of flood alleviation in Ghana and Accra is no exception. These institutions by Acts and other legislative instruments are empowered to deliver both engineering and non-structural interventions that minimise the impact of floods on households. For example, the Local Government Act of 1993, Act 462 confers the powers of planning to district, municipal and metropolitan assemblies. Among the various planning functions vested in the assemblies by Act 462 is the power to check unauthorised physical developments in watercourses and other public spaces. Section 55 of Act 462 stipulates that:

> *"A district planning authority may without prior notice, effect or carry out instant prohibition, abatement, alteration, removal or demolition of an unauthorised development carried out or being carried out that encroaches or will encroach on a community's right of space, or interferes or will interfere with the use of that space."*

Furthermore, the Hydrological Services Department is also responsible for "the programming and the co-ordination of coastal protection works; the construction and maintenance of storm drains countrywide and the monitoring and evaluation of surface water bodies in respect of floods" (MWRWH, 2011:15). With public organisations in place, supported by legislations that promote flood adaptation, the expectation was that the impact of flooding, especially in depressed urban localities, would reduce over time. This has not been the case in the Accra Metropolitan Area as progressively the economic cost of flood damages increased from US$2 million to US$4million between 2001 and 2009 (NADMO, 2009). Poor inter agency coordination has been cited as a major reason for the poor performance of public institutions involved in flood adaptation (MWRWH, 2011).

In sum, rapid urbanisation and climate change/variability are likely to increase flood risk among the poor in Accra especially as adaptation within the city remains a major challenge. In this respect the research questions are:

i. What are the reasons for the different perceptions on the causes of flooding in the Accra Metropolitan Area?
ii. What are the actions and challenges of actors involved in flood adaptation in the Accra Metropolitan Area?
iii. Which factors influence household flood risk and proactive private adaptation choices among the poor in Accra?

1.3 Research Objectives

The study seeks to explore private and public proactive adaptation to urban floods among the poor in Accra from an actor-oriented perspective. Specifically, the study objectives are to:

i. analyse the causes of flooding in poor urban communities in the Accra Metropolitan Area from various actor perspectives;
ii. understand the actions and challenges of actors involved in flood adaptation in the Accra Metropolitan Area; and
iii. determine the correlates of household flood risk and private proactive adaptation choices among the poor in the Accra Metropolitan Area.

1.4 The Relevance of the Study

Flooding is a major factor hindering the fight against poverty in Africa's cities and the attainment of the Millennium Development Goal of achieving significant improvement in the lives of slum dwellers (Action Aid, 2006). Under climate change, West Africa is likely to experience an increase in floods in the coming decades. Christiansen et al. (2007) predict that the occurrence of heavy rainfall events and associated flooding in West Africa will increase by 20% in the next decade due to climate change. Already a number of devastating floods have swept across the sub region with the latest round occurring in 2010. The 2010 floods in West Africa affected over 1.8 million persons in coastal states like Ghana, Togo, Benin and Nigeria as well as Burkina Faso, Niger and Chad in the Sahel region (GFDRR, 2011).

Post impact activities in the form of emergency response and humanitarian' assistance for flood victims have dominated media reportage, funding, policy and academic research to the detriment of pre-impact measures in most developing countries (Tschakert et al. 2010). This is against the background that proactive adaptation measures can significantly reduce losses associated with flooding compared to post impact measures (Grothmann and Reusswig, 2006; Kreibich et al. 2005; Duffield, 1993). Kreibich et al. (2005) for example in a study of the August 2002 Elbe flood in Germany concluded that precautionary measures taken ahead of the flood reduced mean damage to buildings and their content by up to 53%. The focus on pre-impact measures in the study is a departure from the reactionary approach to adaptation towards proactive adaptation. The expectation is that the study will contribute to efforts geared towards minimising the adverse impacts of floods on poor households in Accra, a low-income city in which both public and private adaptive capacity is low.

Compared to rural areas, cities will be among the hardest hit units in terms of flood losses. This is because of the concentration of people, accumulation of infrastructure and regional economies of scale in urban regions (Dodman and Satterthwaite, 2008). Urban areas especially in developing countries also have different sources of vulnerability to flood risks compared to rural areas due to poor housing and infrastructure, pollution and social fragmentation (Moser et al. 1994). Furthermore, urban areas are socially and spatially diverse; hence, vulnerability to urban floods will not be evenly distributed across spatial and social groups. Among the numerous socio-spatial groups found in West African cities, the poor living in sub-standard housing in hazardous sites are said to be among those vulnerable to the devastation associated with urban floods and storm surges (Douglas et al. 2008).

The bourgeoning number of poor urban households in these cities with little or no adaptive capacity against urban floods warrants an investigation into the predictors of adaptation choices among this group of persons. The study will contribute to achieving the millennium development goal (Goal 1) on poverty reduction and support the implementation of Ghana's urban policy framework and other policies and plans designed to reduce vulnerability to flood risk and urban poverty.

1.5 Organisation of the Study

The study has eight (8) chapters. Chapter one discusses the link between flooding, urbanisation and urban poverty. The study problem, research questions, objectives and relevance to development policy are also defined in this chapter. Chapter two explores the concept of adaptation from the climate change and risk management discourses. There is also a discussion on the typology of floods. This chapter concludes with the empirical literature review, research gaps, theoretical and conceptual frameworks that guide the study. Chapter three reviews policies and plans with implications for flood adaptation in Accra. The study methodology is laid out in chapter four together with the profiles of Accra and the study localities. In chapter five, a comparative analysis of the causes of flooding in poor urban localities in Accra is presented while chapter six focuses on public adaptation roles, actions and challenges of the various actors involved in flood adaptation in the Accra Metropolitans Area. Chapter seven is a discussion on the determinants of household adaptation choices. It also investigates whether taking precautionary measures minimises flood risk among the poor in Accra. Chapter eight concludes the study; it sets out the findings of the study, recommended policy interventions, as well as possible areas of further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this section the concept of adaptation to climatic hazards notably floods is explored together with a number of empirical studies on household and institutional adaptation to urban floods. The importance of such a review is to situate the study within the conceptual boundaries of adaptation. Empirical literature on public and private adaptation to urban floods are reviewed to identify gaps in the literature as well as the theoretical and conceptual frameworks as well as methodological approaches that can be adopted for the study.

2.2 Adaptation Explored

Climate change is a major populariser of the concept of adaptation if not the singular most prominent driver of the adaptation discourse. Climate change literature presents several perspectives on adaptation. These definitions represent the multiplicity of views and interpretations of climate change which are themselves rooted in the different understanding of the phenomenon (Levina and Tirpak, 2006). A review of a few of these definitions is presented to throw more light on the different perspectives that influence the emerging discourse on adaptation.

The Intergovernmental Panel on Climate Change stipulates that adaptation is “the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. This definition alludes to the fact that there are different types of adaptation, including private, public and reactive adaptation" (IPCC, 2007b:869). From the scientific arena numerous definitions have emerged to explain the concept of adaptation and these have largely been drawn from biology/ecology, sociology and geography. From the perspective of evolutionary-biology, adaptation has been conceived as "a process whereby the members of a population become suited over the generations to survive and reproduce" (Futuyuma, 1979:308 in O'Brien and Holland, 1992).

However, as observed by Schipper (2007) climate change adaptation goes beyond adaptation as encapsulated in the bio-evolutionary discourse. This is due to the level of planning and consciousness associated with the implementation of adaptation measures under climate change. The same point is articulated explicitly by Nelson et al. (2007:397) in their summary of adaptation as "the decision-making process and the set of actions undertaken to maintain the capacity to deal with current or future predicted change or perturbations to a social-ecological system without undergoing significant changes in function, structural identity or feedbacks of that system while maintaining the option to develop."

Social science disciplines of anthropology/sociology and archaeology have also contributed to the understanding of adaptation through the lenses of culture (Schipper, 2007). The conceptualisation of the adaptation process by O'Brien and Holland (1992:37) as "one by which groups of people add new and improved methods of coping with the environment to their cultural repertoire" epitomises this point of view. Culture here is seen to encompass the total material stock and spiritual activities of a group together with their values, systems and practises reproduced overtime that provides direction and meaning to their behaviour (Stavenhagen, 1998). It includes power relations, social networks and technology. Understood in this sense, the importance individuals attach to various activities and the perception of well-being in any society will be embedded in their culture (Ensor and Berger, 2009). Culture therefore defines the limits and provides opportunities for adaptation by rejecting or resisting adaptation options that do not resonate with local culture and/or supporting adaptation measures rooted in existing social norms (Ensor and Berger, 2009). Community based approaches to adaptation are linked with this perspective of adaptation.

Burton et al. (2002:145) describe adaptation as "a wide range of behavioural adjustments that households and institutions make (including practices, processes, legislation, regulations and incentives) to mandate or facilitate changes in socio-economic systems, aimed at reducing vulnerability to climatic variability and change." This expanded definition explicitly covers various aspects of adaptation such as regulation and legislation not explicitly mentioned in the definition by Intergovernmental Panel on Climate Change. Their definition like all others stressing on behavioural and other forms of change due to climate change/variability contradicts Oliver-Smith (2004) perspective of adaptation as human dominion over nature. Whereas the former argues for real adjustments in livelihoods and other spheres of life to meet changes in climatic conditions, the latter emphasises on the role of technological innovation and infrastructure development in sustaining existing livelihoods in the face of environmental change (Schipper, 2007).

Thompkins et al. (2005) see vulnerability as the degree to which an individual, group or system is susceptible to harm due to exposure to a hazard or stress, and the (in) ability to cope, recover or fundamentally adapt. If this definition is juxtaposed with the various definitions of adaptation reviewed above, there is an inclination that adaptation can be viewed primarily as vulnerability reduction. The focus on vulnerability in adaptation, particularly vulnerability to extreme weather events like floods, is largely the contribution of geography to the adaptation discourse (Grothmann and Patt, 2005).

Adaptation to floods, like other climatic change impacts, can be harmful if not well conceived. Under such circumstances, adaptation ends up as maladaptation. Barnett and O'Neill (2010:211) define maladaptation as "action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on or increases the vulnerability of other systems, sectors or social groups." Intergovernmental Panel on Climate Change (2001) provides another perspective, which states that maladaptation is any change in natural or human systems that inadvertently increase vulnerability to climatic stimuli. Policies or actions of this nature apart from increasing greenhouse gases emission and disproportionately burdening vulnerable groups in society also have high opportunity costs. In addition, they reduce incentive to adapt and ultimately promote a dependency syndrome among the adapting agencies or agents (Barnett and O'Neill, 2010).

In all the perspectives on adaptation reviewed above, there is either an explicit or a tacit admission that vulnerability to climate change impacts can increase because of the pursuit of adaptation measures. This notwithstanding, there is a point of departure from the perspective held by Barnett and O'Neil on one side and the Inter-Governmental Panel on Climate Change on the other, worthy of mote. Barnett and O'

Neil (2010) opine that the adverse effects of maladaptation becomes an externality for other units rather than the adapting agent or agency. But from the perspective of the OECD and IPCC the effects of maladaptive actions may extend to other systems but primarily they affect the adapting agent or unit.

Maladaptation may occur as a result of uncertainties associated with climatic predictions, unequal power relations and lack of skills. Inadequate natural and financial assets also reduce adaptive capacity and resilience leading to maladaptation (Ensor and Berger, 2009). Barriers and limitations to human cognition like ignorance may create errors in judgment at various scales of decision-making that engender maladaptive behaviour (Gifford, 2011). Finally, maladaptation may be as a result of ‘omission and status quo biases’ (Baron and Ritov, 2004).

2.2.1 Types of Adaptation

The Intergovernmental Panel on Climate Change’s definition of climate change alludes to different types of adaptation. The cardinal principles in distinguishing between the types of adaptation are intention, time, scale, duration and agencies involved in the adaptation process. Other scholars also mention form (informational, institutional, legal etc.), duration (short and long term) and degree of adjustment in relation to the original state when they discuss types of adaptation (Fusel, 2007; Smit and Wandel, 2006; Huq and Burton, 2003; Smit and Skinner, 2002; Risbey et al. 1999).

Within the temporal context, adaptation can be proactive/anticipatory, concurrent or reactive (Fussel, 2007; Smit and Wandel, 2006). Proactive or anticipatory adaptation takes place before the impact or impacts of climate change is/are observed. It involves long-term decision-making that reduces long-term impacts, risks and vulnerability associated with climate change (Markandya and Chiabai, 2009). Reactive adaptation takes place after the impacts of climate change have been observed (Klein, 2003) while concurrent adaptation takes place during impacts of climate change (Smit and Wandel, 2006). The boundary between proactive and reactive adaptation is therefore whether adaptation was triggered by predictions about the occurrence of a climatic event in future or whether adaptive actions were undertaken at the onset, during or after the occurrence of an event (Levina and Tirpak, 2006).

Coping strategies are also distinguished from long-term adaptation. Short to mid-term measures implemented normally after a climatic hazard in order to combat its negative effects are considered as coping strategies (Nelson et al. 2007). As such, temporal re-locating to higher elevation or an area where there is no flooding during a flood event can be described as a coping strategy. Long-term adaptation, however, takes on a strategic perspective and involves some level of planning (Braun and Aßheuer, 2011). In this case, a planned voluntary resettlement away from a flood zone can be considered as a long-term adaptation measure to urban floods. This distinction emphasises duration of the adaptation measure.

Adaptation can be private or public (IPCC, 2001). Public adaptation measures are initiated and implemented by governments at all levels (global, regional and local). Private adaptation actions are initiated and implemented by individuals, households and private companies. Public adaptation is normally directed at collective needs but rational self-interest drives private adaption decisions (IPCC, 2001). Implicitly, private adaptation occurs at the local level while public adaptation programmes may cut across communities, regions and nations. With private and public adaptation, the argument moves into the domain of scale and agency (Grothmann and Patt, 2005). Such a differentiation fundamentally answers the questions; where does adaptation take place and who is adapting.

IPCC (2001) also differentiates between planned and autonomous adaptation. The latter represents adaptation that does not constitute a conscious response to climatic stimuli. It is triggered by ecological changes in natural systems and by market or welfare changes. This is also referred to as spontaneous adaptation. The former results from deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state (IPCC, 2001). Such a distinction is premised on the intent of adaptation as well as the degree of spontaneity (Smit and Wandel, 2006).

2.2.2 Categorisation of Adaptation

There is a strong point of view expressed by scholars including Keim (2008) and Marten et al. (2009) that vulnerability determines adaptation outcomes. This notion has found expression in Ensor and Berger (2009) approach of classifying adaptation, the vulnerability based approach. This approach to framing adaptation places various adaptation actions on a continuum made up of three interconnected nodes namely vulnerability reduction, strengthening resilience and building adaptive capacity.

In their schema, Ensor and Berger (2009) explain that vulnerability reduction measures target specific hazards, using the no regrets scenario to address short-term needs while addressing potential climatic change. Such measures are appropriate under conditions of high vulnerability and low uncertainty. Adapting to discrete recurring climatic events like floods will require measures that reduce vulnerability at the household and wider community levels (Ensor and Berger, 2009).

In between vulnerability reduction actions and adaptive capacity, are measures aimed at responding to multiple climatic hazards, strengthening resilience. When resilience is strengthened, vulnerability to a wide spectrum of shocks are reduced at once. By strengthening resilience, the ability to absorb shocks and ride out of them with minimum damage is enhanced (Ensor and Berger, 2009). For example, incremental changes in the transmission of infectious diseases as a result of climate change cannot be simply dealt with through reducing vulnerability of households. From the perspective of Ensor and Berger (2009) there will be the need to strengthen resilience by modifying and altering several aspects of household livelihoods and behaviour as well as providing institutional support like health education.

At the apex of the vulnerability based classification is building adaptive capacity. According to Chapin et al. (2006) adaptive capacity encompasses the ability of actors in a particular human and environmental system to respond to, shape and create changes within the system. The availability of assets and infrastructure, political power, institutions as well as social networks influence the adaptive capacity of a system (Ensor and Berger, 2009; Brooks et al. 2005).

2.3 Vulnerability: A Central Theme of Adaptation

Several definitions and discussions on adaptation either mention or allude to vulnerability (reduction) as a central theme of adaptation (Marten et al. 2009; Ensor and Berger, 2009; Thompkins et al. 2005; IPCC, 2001; Burton et al. 2002; Pielke, 1998). Vulnerability is a broad utility concept that connotes different meanings to different people. This notwithstanding, how actors interpret vulnerability largely influence decisions on the type of adaptation as well as adaptation funding arrangements (Huq and Burton, 2003). In the climate change discourse, vulnerability is described as "the degree to which a system or unit is likely to experience harm due to exposure to perturbations or stresses" (Roy et al. 2012:11). Apart from exposure to hazards and recovery rates by systems, vulnerability also involves factors that condition the capacity of systems or units to cope with hazards, shocks and stressors (Sherbinin et al. 2007). It is a function of exposure (who or what is at risk), sensitivity of system (the degree to which populations and places can be harmed), the character, magnitude and rate of climatic perturbation as well as the adaptive capacity of the unit or system (Adger, 2006; IPCC, 2001; Cutter, 1996).

Three broad conceptions of vulnerability are found in the hazard literature namely, vulnerability as pre-existing condition, vulnerability as tempered response to disasters and vulnerability of place (Cutter, 1996). When vulnerability is conceived as pre-existing conditions, the discourse is reduced to the distribution of hazardous zones and human occupation in these places as well as the frequency and character of hazardous events in eco-fragile zones. The definition of vulnerability as "the degree of loss to a given element at risk or set of elements of risks resulting from the occurrence of a natural phenomenon of a given magnitude expressed as a scale from 0 (no damage) to 1 (total damage)" by UNDRO, (1991) reflects this position.

As tempered response, vulnerability is interpreted as coping responses. In this worldview, 'hazard' is socially constructed and its geo/biophysical nature is de-emphasised (Cutter, 1996; Blaike et al. 2004). Vulnerability to hazards becomes rooted in historical, cultural and socio-economic processes that influence the capacity of households and societies to cope and respond to hazards (Blaikie et al. 2004; Adger, 1999; Pelling, 1999; Mustafa, 1998). Vulnerability as hazard of place is a more integrative concept. The thrust of this concept, 'place', has social, temporal and spatial connotations as it represents both geographic locations and the social of context of vulnerable people and places (Cutter, 1996; Cutter et al. 2008).

Cannon (2000) however expands the concept of vulnerability to cover the following components:

i. self-protection, the ability and willingness of the system, with a given level of knowledge of apparent risk, to adequately protect itself or avoid the hazardous environment;
ii. social protection, which is the ability and willingness of social and political institutions like traditional authorities, the state and local government authorities that are above the individual and household level to protect individuals and households from hazards;
iii. social capital described as the soft security provided by group synergy and networks across time and space that enhances or reduces resilience; and

iv. initial well-being, which is an appraisal of well-being prior to the impact of the hazard and livelihood resilience, a measure of the capacity of a system (household, individual, community) to cope with the post impact conditions and re-establish livelihood patterns after a climatic event.

Vulnerability under climate change draws heavily from natural hazards as well as the concept of entitlement and autarky, which are deeply rooted in the pro-poor development discourse (Adger et al. 2003). However, vulnerability is not the same as poverty (Cannon, 1994) neither is it the preserve of the poor as shown by Brouwer and Nhassengo (2006) in the case of floods in Mozambique, where higher economic loss were reported among the rich compared to the urban poor. Whereas poverty is a state of deprivation, lack or want, vulnerability connotes defencelessness, insecurity and exposure to risks, shocks and stressors (Chambers, 1989). Nevertheless, vulnerability influences poverty outcomes. It encapsulates factors like ignorance, gender and spatial inequality as well as social exclusion and marginalisation, which drive people into poverty and prevent them from exiting the poverty trap (Action Aid, 2005). It results from lopsided development, manifested in the several ways including environmental degradation, rapid urbanization and urban sprawl and limited livelihood opportunities for the poor (Cardona, 2011; Cannon, 2006).

Vulnerability can also be physical or social. Social vulnerability describes demographic, institutional and socio-economic factors that increase or reduce the impacts of hazardous events on a given population (Tierney et al. 2001). Physical vulnerability deals with exposure to risk and (in) ability to absorb potential harm in the built environment namely settlements, infrastructure and property (Pelling, 2003; Cutter, 1996). Within this broad concept of physical vulnerability, one can situate the perspective of the geographic domain of a hazard.

A distinction is made between 'vulnerability to' and 'vulnerability from' something (Ensor and Berger, 2009). The former describes vulnerability to a particular outcome such as homelessness while the latter is a relationship between vulnerability and risk, that is, vulnerability from an exposure (Summer and Mallett, 2011; Alwang et al. 2001). Vulnerability in the climate change and disaster management discourse is normally understood within the framework of 'vulnerability from'. It denotes the absence or presence of certain conditions that make units prone to certain hazards and/or reduces their resilience to hazards.

Kelly and Adger (2000) speak of vulnerability as a 'starting point' or 'end point' of adaptation. They further explain that when studying vulnerability as the starting point of adaptation, the emphasis is on identifying the factors that exist endogenously of climatic hazards but are embedded in socio-economic and political conditions, which increase systemic susceptibility and reduces adaptive capacity to climatic stressors. Starting point vulnerability looks at the vulnerability context and processes within systems (Ensor and Berger, 2009). Endpoint vulnerability measures the effectiveness of adaptation options in terms of building resilience and coping capacity. It refers to residual livelihood impacts occurring after the implementation of an adaptation option or options (Kelly and Adger, 2000). If floods are considered as climatic hazards then starting point vulnerability analyses will look at existing institutions for water shed management and co-operation between up and downstream communities and institutions, while impacts after the construction of levees will be considered as a measure to reduce end point vulnerability.

2.4 Institutions and their Role in Adaptation to Environmental Risks

The role of institutions in adaptation cannot be overemphasised (Agrawal and Perrin, 2008; Tol et al. 2003; Adger, 2000; Bakker, 1999) especially among the poor in urban areas (Roy et al. 2012; Dodman and Satterthwaite, 2008). Specific to climatic risks like floods, Agrawal and Perrin (2008) maintain that institutions influence vulnerability and adaptation choices. They also mediate in the social and political processes through which adaptation unfolds.

Young (2002:5) speak of institutions as "systems of rules, decision-making procedures and programmes that give rise to social practices, assign roles to the participants in these practices and guide interactions among the occupants of the relevant roles." Hodgson (2006:2) views institutions as "systems of established and prevalent social rules that structure social interactions", with examples including law, money and organisations, though Hindess (1989) and North (1994) may want organisations to be treated as actors rather than institutions. For Agrawal and Perrin (2008:2) institutions are "humanly created formal and informal mechanisms that shape social and individual expectations, interactions and behaviour." The mechanisms mentioned by Agrawal and Perrin (2008:2) above include rules, norms, customs, compliance procedures and ethics that 'constrain' human behaviour (Feeny 1988). Institutions do not only 'constrain' behaviour, they also provide incentives for accordant behaviour (Hodgson, 2006).

Institution could be formal or informal (Fatti and Patel, 2013; Næss et al. 2005; Helmke and Levitsky, 2004; North 1990). Formal institutions are openly codified as they are established and communicated through official channels whereas informal institutions are socially shared rules, usually unwritten, created, communicated and enforced outside of officially sanctioned channels (Helmke and Levitsky, 2004). Typical examples of formal institutions are central and local government agencies whereas labour exchanges and collective gatherings are classified as informal institutions (Agrawal and Perrin, 2008). Although such a distinction between formal and informal institutions may be necessary, it is problematic (Hodgson, 2006). In the first place informal institutions enjoy wide spread acceptability and persistence in a given population comparable to formal rules (North, 1997). Secondly, formal institutions derive their legitimacy from non-legal rules and in explicit norms (Hodgson, 2006).

There is a protracted debate over whether actors influence structures or vice-versa (Hogdson, 2006; Wegerich, 2001). Actors are people with knowledge about social phenomena who can intervene in the flow of specific events or in the state of affairs (Giddens, 1984). New institutional economist and structuralist push for the objective position that social structures fundamentally constrain human behaviour by setting clear boundaries that define the limits of actor choices (Ingram and Clary, 2000; North, 1990). In contrast, sociologist of the phenomenological and hermeneutic traditions put emphases on the role of actors and human agency in shaping the 'rules of the game' by situating institutions within "settled habits of thought common to the generality of men" (Veblen, 1909:626). Commons (1934) however provides a common ground that hints of the complementary roles played by structures (rules) and human agency (actors). Institutions can therefore be viewed from both the actor and structural perspectives (Wegerich, 2001).

2.5 Adaptation to Floods from A Disaster Management Perspective

Floods lead to hydro-meteorological disasters. Therefore, disaster risk management practises are required to minimise their impact on human welfare. However, there are differences in the conception of adaptation between the climate change and disaster risk management domains worthy of note. The hazard literature identifies with adaptation to disasters through preventive, impact minimising and post impact recovery measures (Blaikie et al. 2004).

In disaster risk management, a distinction is made between pre-impact risk reduction activities and post impact crisis management. Kreibich et al. (2005) in a study of private flood loss reduction in Germany equated risk reduction measures to preparedness. They posit that preparedness consists of preventive, precautionary and preparative measures. In their view, prevention aims to avoid damage primarily by appropriate land-use or structural measures, preparation tries to manage and cope with the catastrophe while precaution is geared towards damage mitigation through flood proofing.

Another school of thought has it that pre-impact measures are made up of prevention, preparedness and mitigation measures whereas post impact crisis management activities are response and recovery efforts (Keim, 2008, Yarnal, 2007; Schipper and Pelling, 2006).

Preventive measures are taken to avoid being affected by an event whereas preparedness activities are undertaken in advance to ensure effective response to the impact of hazards should they occur (Keim, 2008; Yarnal, 2007; Blaikie et al. 2004). Preparedness measures include creating rapid response units while re-locating people from flood plains and areas liable to flood are preventive measures against flooding (Yarnal, 2007). Mitigation measures on the other hand are measures undertaken prior to the occurrence of an event to limit the adverse impacts of the hazard (Jabeen et al. 2010; Schipper and Pelling, 2006; Blaikie et al. 2004). They are also referred to as flood abatement measures or flood alleviation schemes especially when conceived as large projects (Penning-Rowsell et al. 2006; Naess et al. 2005). According to Hague and Burton (2005:341) disaster mitigation measures are, “the wide array of actions that can be taken to reduce vulnerability” to hazards.

Mitigation measures consist of both structural and non-structural measures (Smith, 2004; Parker, 1999). The structural measures are engineering and in the case of urban floods, they control river flow and/or contain the spread of flooding. Interventions like river channel modifications, constructing levees, embankments, reservoirs and barrages are examples of structural measures for flood mitigation. Non-structural measures seek to reduce the impact of hazards on livelihoods. They include soft interventions like weather forecasting and early warning systems, land use controls, building regulations and insurance services (Parker, 1999). While structural or engineering measures reduce the probability of flooding, non-structural measures reduce vulnerability to floods (Harries and Penning-Rowsell, 2011). The concept of ‘mitigation’ under disaster risk management is different from mainstream climate change mitigation. Whereas mitigation in the hazard literature is analogous to proactive adaptation in the climate change discourse, climate change mitigation involves initiatives to reduce greenhouse gas emissions (IPCC, 2001).

Risk reduction activities tend to be cost effective and sustainable compared to crisis management measures because they are geared towards building reliance towards particular climatic hazards (Keim, 2008). Generally, such activities are community based. Crisis management measures are normally delivered post impact by international and national agencies. It consists of response and recovery operations (Keim, 2008; Yarnal, 2007). Response operations are the emergency assistance activities that take place during or immediately after a disaster with the intention of saving lives and meeting the basic needs of disaster victims like food, water and shelter (Yarnal, 2007). Recovery efforts are aimed restoring normalcy after a flood or disaster event. It involves short-term emergency response to restore essential services and infrastructure such as health, electricity and transportation as well as long-term reconstruction efforts (Yarnal, 2007). It can therefore be argued that post impact crisis management measures in the form of emergency response and reconstruction activities can be considered as typical reactive adaptation measures in the climate change adaptation discourse.

Precautionary, preventive and preparative measures as well as flood proofing, flood mitigation, alleviation and abatement are used as synonyms of proactive adaptation to floods in this study. They encompass all pre-impact activities undertaken to minimise the impact of flooding on households. Unless otherwise stated these terminologies are assumed to have the same meaning. This defines the conceptual limits of the study because the study covers only activities undertaken to reduce exposure and vulnerability prior to a flood event. Preparedness, response and recovery measures as considered by Keim (2008), Yarnal (2007), Schipper and Pelling (2006) are outside the scope of this study.

2.6 Social Domains in Disaster Response

Social domains refer to areas of social life that are organised with reference to a series of interlocking practices and values (Villarreal, 1994). Social domains in disaster studies are the domain of international science and disaster management, the domain of disaster governance and the domain of local knowledge and coping practises (Hilhorst, 2013; 2003). None of these domains assumes a hegemonic position over the others (Hilhorst, 2003).

Within the domain of international science and management, the dominant paradigm is the 'hazard centred' approach with its focus on geo-physical processes. This field largely consists of geologists, seismologists, meteorologists, engineers and other physical scientists who have the capacity to monitor and predict hazards. The role of social scientists in the hazard centred approach is to explain risk perception and design early warning systems (Oliver-Smith, 1996). The domain of international science and management is grounded in the capitalist modernity discourse in which nature is considered as a commodity, separate from society. Disasters are seen as occasional abrasion from nature that can be predicted, controlled and mitigated through expert (scientific) knowledge and western technology (Escobar, 1999). Civil engineering works such as flood embankments and preparation of disaster plans are the major mitigation measures to control hazards under this domain while emergency response is through military style organisations (Hewitt, 1983).

The domain of disaster governance is where negotiations on societal priorities in relation to risks, vulnerability and adaptation to disasters take place. It is the domain where political and bureaucratic governance practices as well as institutions influence disaster knowledge and management. Politicians and technocrats bring their interest, values and ideas to bear on disaster response in this domain (Hilhorst, 2003). Under disaster governance, multiple institutions are assigned the responsibility of disaster management. Some of these organisations may be under local government authorities with others being more centralised in their organisational layout. The disaster governance approach is about state-society relations and how it conditions risk perception, interpretation of risk and response to disasters (Hilhorst, 2013). Disasters can engender policy and social change or they may deepen existing vulnerabilities when the elite take advantage of their occurrence to profit from victims as in the case of flooding in Mozambique (Hillhorst, 2003; Holla and Vonhof, 2001).

The domain of local knowledge and coping strategies describes the numerous ways in which local people cope with disaster, through their own capacities, resources and social networks (Hilhorst, 2013; 2003). Three strands of local knowledge have been identified in the development literature, which are also applicable to disaster mitigation and response (Hilhorst, 2013). The first strand acknowledges the wealth of information embedded in local institutions that can be tapped for disaster management and mitigation. The second and third approaches are criticisms of modernist approach. While the second sees local knowledge as an alternative to the modernist approach, the final strand considers local knowledge as a source of political and economic empowerment of local people. It is centres on self-reliance, ecological soundness and popular empowerment (Hilhorst, 2013). This notwithstanding, local knowledge is not homogenous within and across communities; it is shaped by interface with other knowledge domains like scientific and bureaucratic knowledge (Arce and Long, 1992).

2.7 The Nature of Urban Poverty

Fundamentally, definitions, measurement and concepts about poverty have focused on the income and direct consumption approach. These approaches estimate poverty via the monetary value of a ‘minimum food basket’ with small allowance made for few non-food essentials. These approaches are suitable for cross-country comparisons after adjustment for purchasing power parity. But several scholars (Yankson and Owusu, 2007; Wratten, 1995; Satterthwaite 1995) have questioned the usefulness of this approach in the urban setting because of the commoditisation of urban markets. These scholars have advocated for a more comprehensive approach for understanding the complex interrelationships of various parameters within the urban space as well as how these processes produce urban poverty.

Renewed interest in conceptualising poverty gained currency in the 1990s after structural adjustment programmes failed to reduce but rather exacerbated urban poverty (Yankson and Owusu, 2007). Presently, there is wide consensus among scholars that urban poverty is multidimensional (Baud et al. 2008; Mitlin, 2003; Wood, 2003). The multi-dimension approach to understanding urban poverty situates the phenomenon within deprivation from employment and income generating activities, adequate housing and infrastructure services, social protection, participation in governance and personal security (Baud et al. 2008; Wratten, 1995). Wratten (1995:27) further suggest, “Whilst these are not exclusively urban, they combine in ways that intensify insecurity and life threatening health risks experienced with poverty in urban areas.” These features are discussed thematically below.

Limited Access in the Housing and Land Markets

The urban poor in southern cities often have limited choices in the urban land and housing markets because they cannot afford well-planned and serviced sites. They squat, rent or develop sub-standard housing in hazardous areas prone to flooding and other natural disasters. These hazardous areas, notably wetlands, may be within the city or in speculative-sub divisions in the periphery of cities in the developing world (Fatti and Patel, 2013; Braun and Aßheuer, 2011; Jabeen et al. 2010; Songsore et al. 2009; Yankson and Owusu, 2007).

Slums and other poor urban settlements are characterised by high densities and over stretched housing infrastructure. In the central district of Lima, Peru for example, 50% of the families had incomes below the official minimum wage. The mean square metre per person (4.2) was also less than 10 square metres per person considered as overcrowding (Harms, 1997). The room and house occupancy rate for Accra is 2.9 persons per room and 19 persons per house respectively (Accra Metropolitan Assembly, 2003; Housing and Urban Development Associates, 1990). These metropolitan averages are below what pertains in Ga Mashie (Old Accra), a low-income community, where an average number of 48 persons can live in a house with a density of seven (7) persons per room (Environmental Management Consult, 1999).

It is erroneous to assume that the poor solely occupy low-income housing areas. Aryeetey and Anipa (1992) allude to the penetration of the poor into typical high-income residential areas and a mixture of socio-economic groups in poor neighbourhoods in Accra. Moreover, it is not only poor people who occupy illegally. In El Salvador, while a number of low-income housing areas have been approved by the city planning authorities, most of the other neighbourhoods share their illegal status with Colonia Escalon, the most luxurious upper class residential area (Gilbert and Gurgler, 1982). In spite of these observations, sub-standard housing and living in hazardous areas are more of an urban poverty than a rural problem (Yankson and Owusu, 2007; World Bank, 2001, Satterthwaite, 1997).

Lack of Physical and Social Infrastructure

Infrastructure and services such as water, storm drains, sanitation and health facilities are more remote to rural dwellers as compared to urbanites. In the urban setting, however, distribution and access to basic amenities favour the rich. In Accra, for example, 67% of the poorest 20% households did not have access to collected refuse while only 10% of the wealthiest 20% households were in the same category (McGranahan et al. 2001). Akuffo (2007) in a survey of informal settlements in Accra found that only 8% had in-house plumbing. In Metro-Manila, 85% of the households did not have access to sewers and individual septic tank and 1.8 million people lack educational facilities (Hardoy and Satterthwaite, 1987). The lack of infrastructure increases the vulnerability of poor urban households to flooding by increasing exposure and reducing coping and adaptive capacity.

The huge infrastructure deficits recorded in blighted localities are because they are characterised by low incomes, complicated site layout, spatial ambiguity and difficult terrain (Hogrewe et al. 1993). These fuel the perception among service providers that infrastructure provision in these communities is not cost effective. This perception cannot be supported empirically as there is ample proof that poor city dwellers have effective demand for basic services. Residents of deprived and under serviced communities pay more per litre of drinking water than richer urbanites. It is common for residents of slums and squatter settlements to pay private vendors between four to hundred times more per litre of water than the middle and upper income groups who pay the publicly approved tariffs (UN-HABITAT, 2003b; Kudom-Agyeman, 2002). The scarcity of social amenities in these localities therefore may not always reflect lack of effective demand but rather institutional rigidities and physical barriers to supply.

However, in recent times, some low-income communities and inner city slums have benefitted from upgrading projects. These projects have brought significant environmental improvements in poor urban localities including employment opportunities, strengthening social networks as well as improved access to water and sanitation facilities (Amis, 2001).

Limited Access to Public Institutions and Participation in Governance

Mitlin (1999) argues that whilst there is no reason to believe that social capital is lacking in poor urban communities, there is compelling evidence suggesting that the poor are under-represented in political organisations. This notwithstanding, Beard (2000:374) argues that extreme poverty in urban areas, may itself reduce social networks because of the inability to reciprocate. In a study in Yogyakarta (Indonesia), she emphasises,

> *"In many urban areas, not having food reflects not having money to buy it; and if a household does not have money to buy food, then it is unable to spend money on social obligations. The resultant social exclusion compounds the problems of poor families, isolating them from the social contacts who might assist them."*

While the urban poor may be at the periphery of the urban management decision-making process, they may benefit from political party activity and under populist governments. Drakakis-Smith (1976:12) notes that, "in Turkey as political parties become more evenly balanced so did squatters receive *de facto* recognition of their occupation and gained access to many facilities such as surfaced roads, electricity and water connections." Under Peron's rule in Argentina and in Rojas Piniella's Colombia, the urban poor received more services and city authorities threatened their settlements less frequently (Gilbert and Gugler, 1982).

Poor Livelihood Opportunities

The urban poor either are unemployed or mostly make a living from low paying semi-permanent wage employment in the formal sector and in the informal sector as petty traders and artisans (Satterthwaite, 1997). Low educational attainment is partly responsible for this observation. Most poor people do not have the prerequisite for employment in professional and managerial occupations in the formal sector that guarantee high wages, social security and offer job security. The 'casualization' of employment in Uttah Pradesh, India between the 1970s and 1990s improved the employment opportunities of casuals. The proportion of casuals in the employment mix increased from 11% in 1973 to almost 24% in 2000. A survey, however, revealed that two-thirds of the households whose primary income came from casual labour employment were poor (World Bank, 2002:74).

Alwang et al. (2002) also show that the increase in poverty in Zimbabwe in the early 1990s was more in households that were dependent on earnings from the urban informal sector. The low paying informal sector and the seasonal nature of semi-permanent formal employment combined with the high food and non-food expenditure increase the vulnerability of poor urban households within the volatile urban economy.

This notwithstanding, the gap between incomes from formal and informal jobs may be over exaggerated. A number of studies in New Delhi, India found out that average earnings from the formal sector were only 9% higher than informal sector jobs (Banerjee, 1983). Apart from this, the informal sector with little or no deductions in the form of taxes and social security as well as flexible working hours may also be more appealing to poor urban compared to the more bureaucratic formal sector. The foregone may be a more compelling explanation for the lower share of the urban poor in the formal sector and not the lack of qualification and educational attainment.

Urban Poverty and Vulnerability to Ill Health

World Health Organisation (WHO) refers to poverty as the world's biggest killer (World Health Organisation, 1995). Poor urban communities have higher mortality rates as compared to the rural and wealthy urban neighbourhoods. African Population and Health Centre (2002) reports that in the year 2001 under-five mortality was higher in low-income areas of Nairobi (150.6/1000) compared to rural areas (113.11/1000) and the whole of Nairobi (61.5/1000). A similar trend was also reported in Accra (Ghana) where the Crude Death Rate (CDR) of 5.5/1000 in 1991 showed wide disparities across ecological (residential) zones. The rates ranged from as low as 1.3/1000 in Airport Residential Area, a High Cost Residential Area to 23.3/1000 in Old Dansoman, a deprived community inhabited by the poor (Stephens et al. 1994:32). Mortality in deprived communities has been primarily due to contagious and non-communicable diseases associated with the debilitating housing and environmental conditions under which the poor live and work (Hogrewe et al. 1993; Hardoy et al. 1990). These conditions increase the frequency and intensity of human contact with pathogens and vectors as well as susceptibility to the adverse impacts of hazards like urban floods.

Stephens and Harpham (1992) make the point that environmental conditions as well as the availability of health and emergency services influence health outcomes of the poor. The critical issue here is the performance of health services in terms of coverage and quality of service. On this score, the urban poor are better off compared to the rural poor. Asenso-Okyere (1995) argues that increasing budgetary allocation to support curative health to the detriment of primary health care programmes has improved physical access to health facilities in the urban areas. The poor in living urban areas by virtue of their geographical location are better positioned to enjoy the extended benefits of the increase in expenditure on urban curative health compared to their counterparts in rural districts.

<u>Vulnerability to Crime and Corruption</u>

Slums and other low-income neighbourhoods are particularly more susceptible to crime and corruption. In Delhi, for example, the average bribe paid by an ordinary household seeking redress on a particular government service was 254 Rupees as compared to 337 Rupees in slums (World Bank, 2002:28). It is also widely believed that violent and victimless crimes and other delinquent behaviours are associated with inner cities and peri-urban slums as compared to rural and wealthy urban neighbourhoods (Gilbert and Gugler, 1982).

2.8 Floods: A Review of the Taxonomy

For successful adaptation to flooding, knowledge about the typology of floods is required to inform the choice of adaptation strategies (Jha et al. 2011b; Cuny, 1991). Floods come in different forms; hence, a precise definition for the phenomenon is some-what problematic (Parker, 2000). Floods are temporary conditions of surface water (river, lake, sea), in which the water level and/or discharge exceeds a certain value, thereby escaping from its normal confines. However, this does not necessarily result in flooding (Munich-Reinsurance Company, 1997).

Flooding, according to Few (2004:7), occurs when "excess accumulation of water across a land surface: an event whereby water rises or flows over land not normally submerged." The definition of flooding is extended to cover the "flow of water over areas which are habitually dry" (Jha et al. 2011a:3). The destructive tendency of flooding is highlighted by Nyarko (2000:1040) in referring to flooding as "the inundation of an area by unexpected rise of water by either dam failure or extreme rainfall duration and intensity in which life and properties in the affected area are under risk."

Floods are mostly destructive but some positive externalities of floods are improved soil fertility through replenishing soils within flood plains with nutrients and providing freshwater for spawning of some aquatic animals (Casanova and Brock, 2000). Floods may also wash away habitats vectors like mosquitoes reducing the incidence of malaria and other vector borne diseases (Codjoe et al. 2014; Songsore et al. 2009).

The causative weather events of flooding are rainfall of long duration and/or heavy intensity, tidal and wave extremes in the form of tsunami and storm surges as well as thawing ice as in snowmelt and Jökulhlaup (Few et al. 2004; Few, 2003). Other causes are structural failure of dams and sea defences but heavy rainfall remains the singular most important cause of flooding worldwide (Few et al. 2004).

The typology of floods is characterised by different classifications. Few et al. (2004) simply distinguishes between inland and coastal floods of which the former includes flash or rapid onset, slow onset and riverine floods and sewer/urban drain floods. Cuny (1991) identifies four basic types of floods namely:

i. Flash floods caused by rapid accumulation of runoff from rainstorms in mountainous or hilly areas flowing through confined areas like gullies, wadis or arroyos, until they reach streams or wider, less restrictive areas where the waters spread out and slow down;
ii. Standing floods occurring when accumulated rainwater cannot drain off the surface rapidly nor be absorb quickly into the soils or the water table;
iii. Coastal floods as a result of storm surges caused by tropical cyclones or storm-related high tides; and

iv. Riverine floods, when a river overflows its banks because of heavy rainfall within the catchment of the river. This is also referred to as fluvial floods (Houston et al. 2011).

In addition to the above, others also speak of pluvial floods, which describes the situation when rainfall ponds or flows over land before entering a natural or an artificial drainage system or watercourse, or when it cannot enter because the system is already overloaded (Prudhomme et al. 2010; Golding, 2009). Flooding of this nature is peculiar to urban built areas where runoff velocity is high and drainage systems are underdeveloped (Golding, 2009).

2.9 Empirical Literature Review and Research Gaps

Generally, studies on flood adaptation have been conceived within the human security framing of adaptation. Research using the human security framing approach to adaptation have tended to explore vulnerability, social capital, institutions and other wider environmental and social factors and how they condition adaptation outcomes at both the micro and macro-levels (O' Brien, 2007). A number of these studies are reviewed to guide the choice of theoretical and conceptual frameworks for the thesis as well as the study methodology.

2.9.1 Overview of Studies on the Causes of Flooding in Accra

The causes of flooding and flood typology have been severally studied (Houston et al. 2011; Douglas et al. 2008; Few et al. 2004; Few, 2003; Cuny, 1991). These studies have concluded that flooding in cities is largely because of heavy and/or intensive rainfall, snowmelt, dam failure and storms (Few et al. 2004; Few, 2003). Other causes are settlement development within river basins, changes in hydrology and poor drainage (Douglas et al. 2008).

In Accra, several disciplines have provided both theoretical frameworks and methodological approaches for investigating this problem. Studies using biochemical analyses have concluded that flooding in Accra is as a result of increased sediment loading in drains and water bodies in the city due to poor waste management (Nartey et al. 2012; Kakari et al. 2006; Boadi and Kuntinen, 2002). Aboagye (2012b), Karley (2009) and Afeku (2005) reduce the discourse to population explosion due to urban bias as well as neo-liberal macro-economic policies of government (structural adjustment) and a dysfunctional urban planning system. According to these scholars, the factors above spurred encroachment of waterways and wetlands amidst deficits in the supply of municipal services and urban infrastructure like drains.

Climate scientists have also presented their account of the problem, predicting return periods (Kwaku and Duke, 2007) and arguing that increase in the intensity of rainfall will increase the extent of the areas liable to flood in Accra (Nyarko, 2002). There are also geomorphological studies that have produced empirical evidence pointing to the fact that Accra's open-low lying coastal front together with a depleted beach sediment base underlie its vulnerability to coastal flooding and erosion from wave action and storm surges (Addo and Adeyemi, 2013; Amoani et al. 2012). Twumasi and Asomani-Boateng (2002) have also mentioned the clayey nature of Accra soils with its high water retention as a contributory factor to the flooding experienced in the city.

Research Gap

Although each of the disciplines has theorised about the causes of flooding in Accra and provided a rationale for its occurrence in the city, their different conclusions have led to a fragmented understanding of the causes of flooding in the metropolis. More importantly, the theoretical frameworks and methodological approaches adopted in these studies over emphasise unearthing facts backed by rigorous quantitative analyses and models to the detriment of local knowledge and perceptions.

However, as noted by Hilhorst (2013) and Cash and Moser (2000) local knowledge can contribute to a more comprehensive understanding of how disaster risks unfolds. This study looks at what households and community leaders perceive are the causes of flooding in their communities and analyse their views together with expert knowledge and scientific literature. Such an analysis is likely to improve our understanding of vulnerability to flooding in Accra as well as adaptation to floods in poor communities within the city. This is important as flooding in cities in Africa has been described as a localised problem by Douglas et al. (2008).

2.9.2 Overview of Studies on Public Adaptation to Urban Floods

Studies on institutional adaptation to urban floods have a qualitative outlook (Fatti and Patel, 2013; Harries and Penning-Rowsell, 2011; Adelekan, 2010; Cutter, et al. 2008; Karley, 2009; Penning-Rowsell et al. 2006; Cashman, 2008; Afeku, 2005; Naess et al. 2005; Johnson et al. 2005; Tol et al. 2003; Faisal et al. 1999). Most studies adopt the case study as their research design. Data collection methods at the institutional level were by in-depth interviews with key informants including officials of central and local government agencies involved in flood alleviation. These primary data were supplemented with data from secondary sources (Adelekan, 2010; Cashman, 2008; Naess et al. 2005; Johnson et al. 2005).

In the developed world, studies on public adaptation to urban floods have focused on cultural and institutional barriers to adaptation (Naess et al. 2005; Tol et al. 2003). Others (Harries and Penning-Rowsell, 2011; Cashman, 2008; Penning-Rowsell et al. 2006; Johnson et al. 2005) have explored actor roles and coalitions in the evolution policies for flood adaptation, explaining institutional adaptation to floods using advocacy coalition network, punctuated equilibrium and the policy streams approach.

The advocacy coalition framework hypothesises that policy negotiations occur between actors in competing coalitions, who share different beliefs and values, which then translate into core policy objectives and ideas about specific policy instruments (Sabatier and Jenkins-Smith, 1993; Sabatier, 1998). In punctuated equilibrium, the policy formulation process is theorised to consist of periods of relative stability, punctuated by periods of accelerated change. Periods of relative stability, when there are no disasters or disasters are localised, are characterised by incremental changes in policy while catalytic changes occur when disasters are of a national proportion (Baumgartner and Jones, 1993). The rate of policy change, extent to which actors enter the policy debate and how these actors are mobilised by policy entrepreneurs differentiate these two eras (Johnson et al. 2005). The policy stream approach, however, assumes that disasters of national scale provide 'windows of opportunity' for increasing the number of actors in the policy space, the issues under negotiation and the rate of policy change. Policy change occurs on condition that policy entrepreneurs can seize the opportunity to proffer solutions that are acceptable to decision makers (Kingdom, 2003).

Several conclusions emerge out of the case studies from the developed world. Tol et al. (2003), for example, situate Dutch flood management policies in the concepts of internationalisation, integration, democratisation and ecologicalisation while advocating for greater political will for institutional reforms to deal with future flood risks. Harris and Rowsell-Penning (2006) observe that flood adaptation policy in the United Kingdom is gradually shifting from structural to human centred policies. Moreover, they see flood events as catalysts for introducing existing ideas that has been subjected to public and professional debates into policy, rather than the incorporation of new ideas. Their study also exposed the opportunistic behaviour of actors as they take advantage of flood events to negotiate 'policy streams' that reflect their interests at a particular time.

Roswell-Penning et al. (2011) point out that social identity and public acceptability of structural measures have militated against implementation of non-structural flood adaptation measures at the regional and sub-regional levels in the United Kingdom. Cashman (2008) also emphasises the role of epistemological communities and policy entrepreneurs as drivers of policy change after the Bradford and Glasgow floods in Scotland.

Scholars working in the developing countries have also explored the subject of vulnerability and public adaptation to urban floods primarily through the lenses of political ecology (Aboagye, 2012a; Karley, 2009; Blaikie et al. 2004; Afeku, 2005;

Pelling, 1999; Adger, 1999; Pelling, 1997). In these scholarships, the narratives advance the argument that vulnerability and adaptation to urban floods are not only as a result of natural hazards but also social and economic processes as well as state-society relations rooted in historical antecedents notably colonialism, imperialism and the neo-liberal policy agenda of southern governments. These researchers further argue that these socio-economic and political factors, which influence vulnerability and adaptive capacity, are remote from the hazardous event.

Very few scientists working in southern countries have departed from this top-down theoretical framework. Seminal work by Fatti and Patel (2013) and Adger (2003) have utilised an alternative theoretical approach to political ecology. Fatti and Patel framed their study around how local perceptions and institutional culture explain adaptation at the community level. Adger (2003) investigated the role of social capital in framing private and public institutions that build resilience against weather extremes in Vietnam.

Structural adjustment programmes implemented by most developing countries in late 1970s and 1980s has been associated with rapid urbanisation, urban poverty and unemployment as well as a decline in state provision of basic infrastructure like storm drains. In the case of Accra, Afeku (2005) and Aboagye (2012b) show that structural adjustment intensified vulnerability to urban floods by pricing the poor out of the formal land market into marginal lands liable to flood. This phenomenon coupled with a reduction in public expenditure on urban services increased vulnerability and weakened public adaptation to urban floods in Accra. Pelling (1999; 1997) have also documented the role of historical processes in shaping power relations in George

Town, Guyana, which has affected resource distribution for community-based adaptation to urban floods.

In the case of coastal Vietnam, Adger (1999) fingers the transition from a command and control economy to a more liberalised economic system for undermining community adaptation against coastal storms. He argues that though the transition enhanced market access for agricultural products of a few households, it led to the privatisation of community mangroves and their eventual conversion to aquaculture farms. Adger (1999) further explains how the shift towards capitalism undermined the allocative power of community co-operatives (Communes) and the state in water management. Adger associates these changes with income inequality, rising poverty and the collapse of local institutions and coping mechanisms. The contribution of the studies above together with Pelling (1997), Blaikie et al. (2004) and Douglas et al. (2008) to the public adaptation discourse is that socio-economic and historical processes condition flood vulnerability and public adaptation in time and space.

Research Gap

The framing of public adaptation to urban floods solely within state-society, historical antecedents and socio-economic processes reduce local institutions and the actors within them to a static position in the adaptation process. Such a position is problematic. Primarily, such an argument fails to recognise the fact that most decisions regarding adaptation to climatic hazards like floods are taken by local actors (Cutter, 1993; 2003) based on local interactions and the structure of the governance system (Adger et al. 2005; Wilbanks and Kates, 1999). In addition, such a perspective does not reflect the point of view of Koch et al. (2007) that adapting to climatic events like floods requires a cross cutting and multi-dimensional approach. Apart from this, it fails to acknowledge that adaptation at the metropolitan level will draw on a number of institutions with multiple scales of interaction, knowledge and power relations (Koch et al. 2007; Adger 2003).

This study attempts to examine institutions (organisations) involved in public adaptation and the challenges they face from an actor-oriented perspective. Placing human agency and the interconnectivity of institutions at the centre of the adaptation process marks a departure from the structuralist conception of adaptation, which has at best offered piecemeal solutions to adaptation to urban floods in developing countries.

The new theoretical framework with its focus on actors and the institutions in which they are embedded is expected to contribute to enhancing adaptive capacity of local actors in flood adaptation in developing country cities to deal with future vulnerability to flooding. This is important given the fact that adaptive capacity of institutions in developing country cities is generally low.

2.9.3 Over view of Studies on Household Adaptation to Urban Floods

A review of scholarly works on private (household) adaptation shows that documentation of the various flood adaptation options by various households has been the major pre-occupation of scholars in this subject area (Campion and Venzke, 2013; Sakijege et al. 2012; ILGS and IWMS, 2011; Adelekan, 2010; Jabeen et al. 2010; Aboagye, 2008; Douglas et al. 2008; Nchito, 2007; Atuguba and Amuzu, 2003). Three seminal studies were cited in the literature that went further to discuss the determinants of household adaptation strategies against floods. These are Grothmann and Reusswig (2006) and Lin et al. (2008).

Majority of the studies reviewed sought to explain household adaptation to floods as a function of vulnerability (Sakijege et al. 2012; Adelekan, 2010; Jabeen et al. 2010; Douglas et al. 2008; Nchito, 2007). The notable exception is Grothmann and Reusswig (2006) which was based on the protection motivation theory. Lin et al. (2008) in a large sample survey in Taiwan were not explicit on the theoretical underpinning of their study but their discussions suggested that the theory of planned action by Arjzen (1985) provided the theoretical basis of the study.

A mix of quantitative and qualitative methodologies has been used in these micro-level studies. The qualitative studies in this field explored various coping and adaptation strategies by different households living within flood prone communities using focus group discussions and key informant surveys (Campion and Venzke, 2013; Sakijege et al. 2012; Jabeen et al. 2010; Adelekan, 2010; Douglas et al. 2008; Nchito, 2007). For the quantitative studies, household interviews with structured questionnaires were used as the data collection method. Descriptive statistics in the form of frequency tables and cross tabulations formed the basis of the discussion in most of the quantitative studies (Adelekan, 2010; Jabeen et al. 2010; Douglas et al. 2008).

A few studies have attempted to model the household adaptation decision-making process in urban areas. Grothmann and Reusswig (2006) investigated the relative contribution of socio-economic (education, income, tenancy status) and psychological factors (coping appraisal and threat experience appraisal) to the predictive power of a hierarchical logit model for household flood adaptation decisions among households in the Rhine Valley, Cologne. In the case of Lin et al. (2008) factor analyses were used to cluster variables into five groups. Subsequently, multiple regressions were used to predict the "mitigation" behaviour of flood victims in Taiwan.

The descriptive studies unearthed the diversity of adaptation and coping strategies that various urbanites opt for to protect themselves against flooding. These strategies are mainly evasive measures. The measures include the use of sandbags and tree logs, raised foundation of pit latrines and doorsteps and provision of water outlet pipes above plinth level. Others are construction of embankments, retaining/protective walls and elevation of house foundations (Campion and Venzke, 2013; Sakijege et al. 2012; ILGS and IWMS, 2011; Adelekan, 2010; Jabeen et al. 2010; Aboagye, 2008; Douglas et al. 2008; Nchito, 2007; Atuguba and Amuzu, 2003). The modelling exercise showed that both psychological factors and household socio-economic characteristics influence household adaptation choices (Grothmann and Reusswig, 2006). Li et al. (2008) however stress that there are limits to the influence of the psychological variables in determining household flood adaptation choices.

<u>Research Gap</u>

Generally, empirical studies on household adaptation in the developing world have largely remained in the realm of documenting the vulnerability settings and adaptation/coping strategies among the urban poor. Conspicuously missing in the discourse are empirical studies that provide insights into the various factors that influence household decisions on adaptation against flooding in poor urban households. The lack of studies in this area of adaptation does not auger well for adaptation planning at the local level as vital feedback on household decision-making processes are omitted from adaptation policies, plans and programmes making these initiatives linear.

The study contributes to filling this void in the adaptation discourse. This is because apart from documenting the existing adaptation strategies among the urban poor in Accra, the study explores the role of psychological and socio-economic variables in adaptation decisions among the urban poor to improve the content of adaptation programmes and plans in Africa. As noted by Renn et al. (1992:137), “events pertaining to hazards interact with psychological, social, institutional, and cultural processes in ways that can either heighten or attenuate individual and social perceptions of risk and shape risk behaviour.” It has been predicted that more floods will occur in Africa (Christiansen et al. 2007) and poor urban households will be mostly affected.

2.10 Theoretical and Conceptual Framework

This section of the thesis describes theories that guide various aspects of the study. It discusses political ecology as a dominant frame explaining vulnerability and public adaptation to climatic risks in the developing world and introduces a complementary theoretical framework, the actor oriented approach to guide the study. The actor-oriented paradigm is the overarching theoretical framework adopted for the thesis. Within this broad theoretical framework the roles, actions and challenges of institutions involved in drainage improvement and zoning regulation in Accra as well as how these actors perceive the causes of flooding are explained. The Protection

Motivation Theory guides the investigation into adaptation choices by actors at the household level. These theories are discussed below.

2.10.1 Political Ecology and Institutional Adaptation

Most scholars writing about disaster management and adaptation to climatic hazards in southern countries situate their writings in 'political ecology' (Aboagye, 2012b; Aboagye, 2008; Blaikie et al. 2004; Adger, 2003; Pelling, 1999; 1997). Political ecology emerged in the 1970s and 80s as a distinct field of research from human ecology and ecological anthropology. Its emergence is attributed to the poor treatment of politics within human-environment nexus by human and anthropological ecologists (Vayda and Walters, 1999). By the 1990s, the approach had firmly established itself as a dogma providing an alternative narrative to explain third world environmental challenges (Bryant, 1997).

Third world political ecologists do not subscribe to the neo-classical economic doctrine that the environmental problems of developing countries are as a result of market failure and poverty. Rather, they argue that environmental problems in the South including vulnerability to disasters like urban flood are due to historical and wider political, social and economic processes associated with the expansion of the capitalist order (Bryant, 1997). The expansion of capitalism had created uneven power relations and unequal access to environmental resources between different classes of society, adversely affecting adaptation to climatic risks like floods among vulnerable groups. Blaikie and Brookfield (1987:17) aptly captures this when they submit that political ecology, *"combines the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself"*

Political ecology is a broad area of study. There are aspects that focus on livelihood production and reproduction while others look at the social, economic and environmental change. Other variants investigate the activities of colonial powers, neo-colonial institutions, the state and corporate organisations at the community level as well as conflicts arising out of unequal access to resources and changes in gender roles together with social-environmental marginalization. There are also aspects that are pre-occupied with empirical and historical research (Offen, 2004). Amidst the numerous areas of enquiry, third world political ecology is primarily concerned with how development policies impoverish local people (Stonich, 1998) and constraints their capacity to adapt to hazards (Blaike et al. 2004).

The political ecological approach to understanding vulnerability and adaptation to floods allows for a deeper investigation into the root causes of disasters in time and space (Blaike et al. 2004). It also provides a framework for analysing power relations and uneven resource access within a particular context and their influence on human capacity, vulnerability and adaptation (Blaike et al. 2004; Dagert, 2001). Nevertheless, some political ecologists have fallen into the trap of populist political agenda and the 'green romance' in their pursuit of social justice and equity. Their writing reflects the argument that local ownership of resources is the panacea to the problem of resource degradation and vulnerability to climatic risks in developing countries. Vayda and Walters (1999) contest this position strongly. Significantly, the over bearing interest in 'politics' especially external political influence as the causative factor of poverty and environmental degradation in developing countries masks other factors notably the role of local actors and institutions in engendering social and environmental change (Vayda and Walters, 1999) and adaptation to environmental change (Koch et al. 2007).

2.10.2 The Actor Oriented Paradigm and Institutional Adaptation

Actor-oriented approach to sociology of development has its root in Weber's characterisation of social action as both meaning and practice (Long, 2004). The paradigm emerged forcefully as a reaction to the structural theories namely modernization (1950s), dependency theories (1960s) and political economy (1970s) as well as the post-modernist theories of the 1980s (Long, 1990). Interestingly, this paradigm does not reject the notion of external forces engendering structural change but it alludes to the fact that it is insufficient to analyse social change/processes like adaptation to climatic hazards solely through external interventionism (Long, 1990) and formal institutions (Klein and Juhola, 2013).

The main thrust of the paradigm is that social actors and structures through everyday experiences and perceptions transform and mediate external interventions as they enter the life world of actors (Long, 1994; 1990). Interventions are therefore part of a chain of events emanating from the activities of the state and other social interest groups through inter-institutional struggles (Long and Ploeg, 1989).

Human agency, knowledge and power are the central concepts in this theory as these are seen as vehicles that refine social change (Long, 1999). Social actions/change emanate from human agency within the context of social structures (Hajer, 1995).

Giddens (1984) explains that human agency is the capacity of individuals to alter pre-existing state of affairs or course of events. It provides individuals the capacity to process social experience and cope with life even under coercion (Long, 1990). Through human agency, local actors deal with social constrains and enabling factors through discursive and organisational practices as they accommodate each other in their various endeavours or 'life-projects' (Long, 1999).

Human agency affects the management of interpersonal relations and control among actors (Long, 2001). As a culturally constructed concept, human agency converts individuals into social actors. Social actors, even those in subordinate position, have the power to solve problems and intervene in the flow of events, monitor their own actions, observe how others react to their behaviour and react to contingent situations (Long, 1999). Intentional actions by social actors may have intended and unintended consequences.

Power, according to Weber (1922:53), "is the probability that one actor within a social relationship will be in a position to carry out his own will even despite resistance, regardless of the basis on which this probability rests." Power is not a resource but it influences resource distribution for adaptation. The concept of power suggests domination and control of one agent over the other. Nonetheless, Giddens (1984) who argues that powerless agents still exert some form of control over the powerful ones see it as a two-sided phenomenon. Giddens refers to this phenomenon as the 'dialectic of control'.

Power emerges out of micro-level social negotiations and it is not a preserve of any particular actor within a social system (Arce et al. 1994). It is a product of struggles and negotiations over authority, status, reputation and resources that requires networking with other actors and building constituencies (Long, 1999). Power configurations are therefore "depicted in terms of the idea of interlocking actors' projects made up of heterogeneous sets of social relations imbued with values, meanings and notions of authority and control, domination and competition" (Long, 2001:242).

Proponents of actor-oriented approaches contend that knowledge is constituted by the ways in which people categorize, process and impute meaning to their experiences. It emerges out of a complex process involving social, situational, cultural and institutional factors (Arce and Long, 1992). Furthermore, the case is made that some form of knowledge is embedded in all forms of social situations and these are usually intertwined with power relations and resource distribution (Long, 1999). Long (2004) coins the concept 'battlefields of knowledge' to suggest that actors understanding, interests and values are contested within a certain social arena and within this same arena struggles over social meanings and practices occur among various actors. Long (2004) maintains that the 'battlefields of knowledge' are not limited to the local level, specific institutional settings, 'beneficiaries' or 'implementers' of development policies, programmes and projects, they are inclusive of a wide range of social actors committed to different livelihood strategies, cultural interests and political trajectories (Long and Long 1992; Long and Ploeg, 1989).

The existence of 'battle fields of knowledge' implies the existence of 'multiple social realities' for actors, therefore the evolution of knowledge will involve a complex interplay of social, cognitive, cultural, institutional and situational elements among actors rather than a simple accumulation of logical facts (Long, 2004). Because of this, actor oriented approaches require a deeper understanding and analyses of the processes by which social practices and identities are shared, contested and even rejected by actors within a particular social space. Long (1999) refers to such in-depth analyses as interface analyses. Social interface situations are complex and consist of different interests, relationships, rationality and power. In view of this, interface analyses focuses on points of departure and social differences within broader institutional, knowledge and power domains (Long, 2004).

The key strength of interface analyses is that it goes beyond the simple structural and institutional explanation of social change and solutions to challenges of policy implementation. It draws on different actor responses, perceptions and knowledge constructed and reconstructed through on going interface encounters, struggles and segregations (Long, 1999). In terms of methodology, it stresses on the inclusion of the voices, experiences and practices of all actors involved in experimental learning curves of policy makers and researchers (Long and Villarreal, 1993).

2.10.3 Protection Motivation Theory and Household Proactive Adaptation Choices

Households as actors prior to choosing an adaptation strategy in respect to flooding go through a decision-making process. Theories that explain the individual/household decision-making process under uncertainty are collectively referred to as "value expectancy" theories (Rosenstock et al. 1988). Value expectancy theories are founded on the premise that behaviour is contingent on subjective valuations of outcomes of human actions and probabilities (expectations). In addition, outcomes are as a result of the individuals actions (Rosenstock et al. 1988).

The health belief model (Rosenstock, 1974), protection motivation theory (Rodgers, 1975) and the theories of reasoned action (Arjzen and Fishbien, 1980) and planned action (Arjzen, 1985) are examples of value expectancy theories. The study adopts the protection motivation theory to explain the determinants of household adaptation choices among the poor in Accra. Unlike the other value expectancies theories, which are silent on the rationale for individual/household choice of mal or no adaptation, the protection motivation theory provides an explanation for individuals/households choice of adaptation as well as no or maladaptive actions.

The Protection Motivation Theory, credited to Rogers (1975), was originally developed to provide conceptual clarity on how fear appeals influenced health behaviour. In Rodgers (1983), the theory was extended to explain the role of cognitive processes in behavioural and attitudinal change under persuasive communication (Boer and Seydel, 1996).

The theory posits that adaptive and no/ maladaptive responses to threat are explained by two processes, threat and coping appraisals. Threat appraisal is the assessment of the probability of an event causing harm given no change in behaviour or preventive action. According to Prentice-Dun and Rodgers (1986), it is an evaluation of factors that increase or decrease the probability of making a maladaptive response. The factors are perceived vulnerability to the threat and perceived severity of the threat as well as fear (Prentice-Dun and Rodgers, 1986). These increase both the probability of no/maladaptive response and protection motivation when high.

The components of coping appraisal are response efficacy and self-efficacy. Response efficacy is the judgment about the efficacy of the preventive measure. Self-efficacy, borrowed from social learning theory (Bandura, 1977), is the ability to control one's behaviour (Prentice-Dun and Rodgers, 1986). In this case, it is the ability of an individual or household to carry out a precautionary/adaptation measure to minimise flood risk. Another component of coping appraisal is (perceived) response cost, which represents the assumed monetary and opportunity costs associated with undertaking a precautionary/adaptation response (Prentice-Dun and Rodgers, 1986). High response efficacy and self-efficacy increase the probability of adaptation while a higher subjective evaluation of the response cost negatively affects adaptive response (Grothmann and Reusswig, 2006).

The net effect of threat and coping appraisals explains protection motivation (Boer and Seydel, 1996). The function of the protective motivation variable in the theory is to stimulate, sustain, direct and facilitate preventive/adaptive behaviour (Boer and Seydel, 1996). Protection motivation is synonymous to adaptation intention (Grothmann and Pratt, 2005).

The protection motivation theory differentiates between adaptive and maladaptive responses and thus it is an improvement over the other value expectancy theories, which are silent over the issue of maladaptation and why individuals take maladaptive actions. Adaptation reduces threat, whereas maladaptive responses like denial of the threat, dreaming and fatalism as well as wrong adaptation or no adaptation increases the severity of the threat. Apart from this, the theory brings to the fore the fact that the availability of alternatives to maladaptation is not a sufficient condition for engendering the pursuit of adaptive actions (Boer and Seyel, 1996).

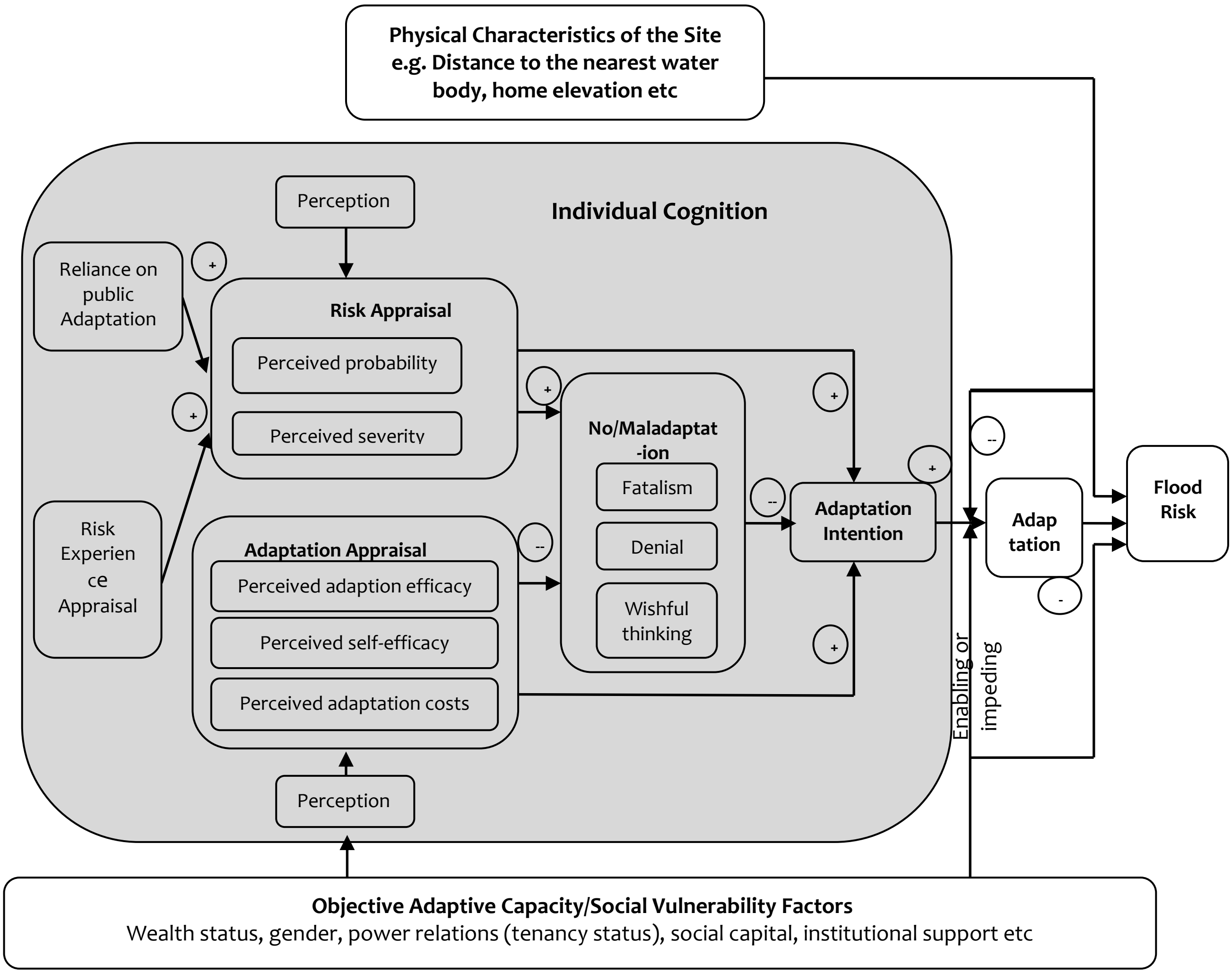
Finally, the theory underscores the role of perceived (social and financial) cost of adaptation as a determinant of protection motivation and hence adaptation/prevention/precautionary choices. The cost element is relevant in that it acts as a catalyst or barrier to adaptation (Grothmann and Patt, 2005). The theory fails to account for objective adaptive capacity elements such as gender and how they influence adaptation choices at the household level.

2.10.4 Conceptual Framework for Household Flood Adaptation Choices and Risk

The study adopts the Model of Private Proactive Adaptation to Climate Change (MPPACC) developed by Grothmann and Patt (2005) to explain the determinants of household adaptation to urban floods, albeit with some modifications. The original form of the model draws extensively on the protection motivation theory. The theory however fails to account for the fact that the physical and social vulnerability setting of households directly influence adaptation choices and the level of household flood risk.

With the new framework illustrated in Figure 2.1, the level of household flood risk is conceived as a function of household proactive adaptation choices, exposure (physical vulnerability) and sensitivity (social vulnerability) to floods. In this respect, variables like home elevation, distance to nearest water body and sex of head of household that capture 'vulnerability of place' (Cutter, 1996), together with the implementation of proactive precautionary measures (adaptation) are combined to explain the extent of the consequences of flooding (flood risk) among households. Nonetheless, household adaptation decisions are the product of cognitive processes and household vulnerability settings (see Figure 2.1 for the schematic of the model).

Figure 2.1: Conceptual Framework for Household Flood Adaptation and Risk Among the Poor



Source: Adapted with Modification from Grothmann and Patt (2005)

From Figure 2.1 and in line with the Protective Motivation Theory, cognitive processes of risk and adaptation appraisal lead to a specific risk perception and perception on adaptive capacity. The schematic (Figure 2.1) also shows that risk appraisal exerts a positive influence on both no/maladaptation and the intention to adapt to a threat like urban floods. Adaptation appraisal involves perceived adaptation efficiency, self-efficacy, and cost of adaptation. Perceived self-efficacy is the subjective judgement about whether the household can implement the selected adaptation measure with available resources while perceived adaptation efficiency is the believe that a chosen adaptation measure will reduce the incidence of flooding and its adverse effects at the household level. Whereas adaptation appraisal is negatively associated with maladaptation or no adaptation, it has a positive effect on the adaptation intention, hence adaptation to urban floods.

Figure 2.1 also illustrates that reliance on public adaptation programmes like publicly constructed drainage systems and household flood risk experiences like property damage due to floods impacts positively on risk appraisal.

Households who decide to adapt form adaptation intentions. The concept of adaptation intention is analogous to 'protection motivation' in the Protection Motivation Theory (Grothmann and Patt, 2006). Adaptation intentions are not the same as adaptation responses though like 'protection motivation' they influence adaptation positively (Boer and Seydel, 1996). The reason is that there are certain factors exogenous of the cognitive processes that influence adaptation. The model describes these variables as objective adaptive capacity variables but they are analogous to the vulnerability setting of households. They include wealth/income status of household, availability of social capital and power relations within the home and community setting. These may aid or hinder adaptation directly. They also act indirectly through perceptions about the household's ability to access an adaptation strategy to minimise the impact of flooding (see Figure 2.1).

When a household undertakes a proactive adaptation (precautionary) measure, then all things being equal household flood risk, measured by household property/asset damage, reduces. In addition, the social vulnerability setting of households and the physical characteristics of the home environment directly influence household flood risk.

Finally, the original model of proactive private adaptation to climate change incorporates adaptation incentives like laws and taboos, which can either facilitate or discourage adaptation. As among the poor in Accra there are no adaptation incentives, the conceptual framework for this study omits this variable.

How the theories, concepts and conceptual framework discussed above influence private and public adaptation to urban floods in Accra will be presented later in chapters five, six and seven but prior to these, policies and plans with flood alleviation content in Ghana are discussed in the next chapter.

CHAPTER THREE

A REVIEW OF POLICIES, PLANS AND STRATEGIES FOR ADAPTATION TO URBAN FLOODS IN ACCRA

3.1 Introduction

In public adaptation, government organisations implement adaptation plans, policies, programmes and projects (Adger, 2003) with the aim of protecting citizens from climatic hazards like floods (Adger et al. 2005). This chapter reviews existing policies, plans and strategy papers for relevant statements that influence flood adaptation in the city of Accra.

3.2 Policies Relating to Flood Alleviation in Ghana

There are policies that discuss flood alleviation in Ghana as one of their themes. These are riparian buffer zones policy, the urban policy framework and the national water policy. These policy documents are reviewed for their objectives and strategies for flood abatement.

3.2.1 Riparian Buffer Zone Policy

The Water Resources Commission prepared a riparian buffer zone policy in 2011. This policy identifies encroachment of watercourses and wetlands as a major cause of flooding in Ghana. To remedy the situation, the riparian buffer zone policy sets out "to preserve or establish green spaces as riparian buffers along waterways in areas that are practically difficult for regeneration and reforestation of riparian vegetation as more efficient ways of preventing drinking water contamination and flooding" (Government of Ghana, 2011:12). Measures outlined in the policy to support flood abatement are provision of minimum standards for delineating reservations for various types of water bodies, enforcement of a no development zones around water bodies and removal of unauthorised structures in reservations around water bodies.

The policy seeks to harmonise policies and laws from other sectors in respect to buffer zones but some of its proposals actually conflict with existing planning standards and legislations. For example, the 60-metre buffer along major rivers stipulated in the Riparian Buffer Zone Policy conflicts with the 30-metre standard set in the National Building Regulations (L.I. 1630, 1996).

3.2.2 <u>National Urban Policy Framework</u>

Recently, the Ministry of Local Government and Rural Development has prepared a national urban policy. The goal of the urban policy is to:

> *"**t**he goal of the National Urban Policy (NUP) is 'to promote a sustainable, spatially integrated and orderly development of urban settlements with adequate housing, infrastructure and services, efficient institutions, and a sound living and working environment for all people to support the rapid socioeconomic development of Ghana." (Government of Ghana, 2012a:21)*

Of the twelve objectives outlined in Government of Ghana (2012a), three relate directly to flood adaptation. These are to promote urban safety and security, ensure efficient urban infrastructure and service delivery and finally to support climate change adaptation and mitigation mechanisms. The strength of the policy in respect of proactive flood adaptation lies is the emphasis on integrating urban planning and management with disaster prevention and preparedness. The recognition of the role of the traditional authority in the management of water resources mentioned in the document is also commendable. The document also sets out to discourage coastal zone development and enforce zoning regulations in flood prone areas within the urban setting.

An action plan has been prepared to guide the implementation of the urban policy framework. The action plan is largely a collection of implementation agencies for each of the thirteen (13) focal areas of the urban policy over a five-year period. Although a cross sectorial approach was emphasised in the action plan, the policy and its accompanying action plan fail to tackle the challenges within and between actors assigned various roles in the action plan for flood adaptation.

3.2.3 National Water Policy

The National Water Policy was formulated in 2007 within the context of Growth and Poverty Reduction Strategy (GPRS II), New Partnership for Africa's Development (NEPAD) and the Millennium Development Goals (MDGs). The policy objective is to "promote an efficient and effective management system and environmentally sound development of all water resources in Ghana." (Government of Ghana, 2007:12). The highlight of the document is the recognition that water resources have competitive and conflicting uses. The document is organised around three themes namely water resources management, urban water supply as well as community water and sanitation. The water resources management theme outlines policy objectives and strategies to curb the impact of floods.

The water resources management theme discusses issues relating to flood abatement under focal areas 1 and 6 that cover integrated water resource management and climate change/variability respectively. In both focal areas, there is an acknowledgement that water resources are finite and vulnerable given its multiple uses. The plan recognises the need to integrate water resources planning with land use planning activities and adopt river basins as planning units. Finally, water resources were to be protected from human activities and river basin management was to be integrated with coastal zone and wetlands management. These sections also make statements about the threat posed by extreme weather events, notably flooding.

Although the water policy outlines sound prescriptions for sustainable use of water resources, a critical review of the policy shows that of the three thematic areas, the focus was more on urban water and community water and sanitation compared to water resource management. For example, there was no clear policy direction for financing climate change and integrated water resource management strategies in the policy. This is against that background that the policy document explicitly spells out financing strategies for urban water and community water and sanitation.

3.3 Flood Adaptation in Structure and Medium Term Plans for Accra

Planning documents have provided some strategies to reduce the incidence of flooding in Accra. Plans for upgrading Accra's drainage systems are contained in drainage master plans, the Strategic Plan for Greater Accra Metropolitan Area and the Medium Term Plans of the Accra Metropolitan Area.

3.3.1 Drainage Master Plans of Accra

As far back as 1963, the first drainage master plan was prepared for the city of Accra. A major proposal under this master plan was the dredging of the Korle Lagoon (Watertech, 2006). Mott Macdonalds Plc. updated this plan in 1991 under the World

Bank Urban III project. Under the revised drainage master plan, a prioritisation of the city's drainage system was undertaken together with construction cost estimates and a schedule for implementation (World Bank, 2004).

The plan established the lining of the Odaw River as the top priority drainage project in Accra. The construction of the Chemu, Onyasia, Mataheko and Odaw drain from the N1 highway to Abossey Okai road under the Urban Environmental Sanitation Project (UESP-1&2) were based on recommendations from 1991 revised Drainage Master Plan. This notwithstanding, most of the recommendations of the 1991 drainage master plan have lagged behind the implementation schedule due to lack of funding and institutional capacity constraints (Watertech, 2006).

3.3.2 Strategic Plan for Greater Accra Metropolitan Area

A strategic plan prepared for the Greater Accra Metropolitan Area (GAMA) in 1992 under the auspices of the United Nations Development Programme also discussed the problem of flooding in Accra. In the plan, flood control measures were outlined, "to develop an efficient drainage management system for the metropolitan area, alleviate flooding and manage drains in flood prone areas" (UNDP, 1992:102).

The plan proposed the delineation of an outer green belt for the Greater Accra Metropolitan Area. In addition, immediate lands (60-100 feet) around all major water bodies in the Greater Accra Metropolitan Area (GAMA) were to be free from human activities. Other proposals in the structure plan were the introduction of community based drainage management and maintenance systems and the establishment of a central agency to co-ordinate maintenance works on the city's drainage network.

These measures were to be complemented by the creation of retention basins with flood gates, the dredging of the Korle and Sakumo (I) lagoons, stream training of rivers and the preparation of a special flood zoning plan to cover areas within the 1 in 15 years flood line (UNDP, 1992). Finally, the strategic plan proposed upgrading of flood prone communities to reduce future cost of flood abatement in the city but cautioned against large-scale re-location of flood prone communities (UNDP, 1992).

Most of the proposals in the strategic plan in respect to land use controls for flood alleviation have not been implemented. The outer green belt has been heavily encroached largely because of lack of enforcement and failure of the metropolitan authorities to complete the necessary land acquisition processes. Reservations, watercourses, and wetlands have also been subject of encroachment and abuse. The Drains Maintenance Unit was finally established in 2005 as a unit under the Waste Management Department but lack of funding and duplication of functions are making the unit ineffective. This unit is responsible for routine maintenance and desilting of Accra's network as well as supervising the construction of secondary drainage systems in the city.

3.3.3 Flooding in Medium Term Plans for Accra

Medium term plans for Accra also allude to the incidence of flooding and outline strategies to minimise perennial flooding in the city. In the last medium development plan for the Accra Metropolitan Area (2010 -2013) poor drainage systems was captured among the top ten development priorities of the Accra Metropolitan Assembly (Accra Metropolitan Assembly, 2010). The theme 'promote infrastructure, energy and human settlement and accelerated agriculture modernization' discussed medium term remedial solutions to improve citywide drainage as means of reducing exposure to urban floods in the city. The objective was to improve and provide good drainage systems within the metropolis by December 2013. The plan proposed a number of projects to minimise the incidence of flooding in selected flood zones in the city. The construction of secondary drains within neighbourhoods was the strategy identified by the Assembly to alleviate flooding in the medium term.

3.4 Ghana's Climate Change Adaptation Strategy

Ghana has a Climate Change Adaptation Strategy, which talks about vulnerability and adaptation to flooding among other stressors associated with climate change. It was prepared to guide adaptation programme prioritisation between 2010 and 2020 under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC) and the Hoyogo Framework (2005-2015). The document acknowledges the adverse impacts of flooding on infrastructure, agriculture, health and housing and its capacity to accelerate rural-urban migration.

Using multi criteria analysis, the strategy paper outlines a list of priority programme areas based on resilience, sustainability, feasibility, replicability and the potential of programmes/projects to have multiplier effects (co-benefits) on the economy. Programme areas that relate to flood adaptation are to focus on strategies that identify and enhance early warning systems, improve land use management, enhance research and awareness creation and implementation of environmental sanitation strategies together with managing water resources.

A major innovation under the strategy was the adoption of a decentralised approach towards the preparation of adaptation plans and the use of a cross-sectoral planning and decision-making tool, ‘the Akropong approach’, during the preparation of the strategy paper. Nonetheless, experts and technocrats largely controlled the preparation process.

3.5 Conclusion

This chapter has discussed the various policies, plans and strategy papers that touch on public adaptation to urban floods in Accra as well as in Ghana. The review shows that technocrats have largely controlled the plan and policy preparation process and implementation. In addition, a number of interventions for flood mitigation lag behind their implementation schedules due to funding and human capacity constraints. Some prescriptions in these documents have also not been mutually re-enforcing of each other and little attention has been paid to inter and intra agencies linkages for plan, policy and programme/project implementation. This notwithstanding, the observation is that adaptation to urban floods will involve a number of actors, formal and informal, with conflicting/competing interest in the use of water and land resources.

CHAPTER FOUR

STUDY AREA AND METHODOLOGY

4.1 Introduction

The study approach and methodology provides an insight to the reasons for selecting the Accra Metropolitan Area for this study. It also presents a profile of the study areas and discusses the study research design, which includes methodology, data collection methods and analytical techniques used in this study.

4.2 The Choice of Accra as the Study Area

The study was carried out in the Accra Metropolitan Area. Accra is a low-lying city along the coastline of Ghana, an area described by Dasgupta et al. (2009) as vulnerable to coastal inundation and storm surges due to sea level rise. The metropolis is also susceptible to urban floods (Kwaku and Duke, 2007). Accra has a history of flooding since 1936 (Ahadze and Proverbs, 2011). Accra's current and future susceptibility and vulnerability to coastal and inland floods have also been severally discussed (Addo and Adeyemi, 2013; Amoani et al. 2012; Rain et al. 2011; Dasgupta et al. 2009; Nyarko, 2000).

Seminal work by Nyarko (2000) using geographic information systems and hydrological models, for example, showed that 41.8% of the Greater Accra Metropolitan Area, Accra and its environs are liable to flood with 35.7% being designated high-risk zones as against 6.1% being very high-risk zones. Nyarko (2000) further warns that the extent of the flood risk zone will increase if the intensity of rainfall exceeds 140mm/day.

More importantly, Accra has the highest flood related mortality in Ghana. The record of forty (40) deaths as a result of the flood event of 4th July, 1995, twenty three deaths (23) from the June 21, 2001 flood and the subsequent loss of 17 lives in the flood of October 26, 2011 firmly establishes Accra as the leader in terms of flood related mortality in Ghana (Aboagye, 2012a; UNEP/OCHA, 2011). One may argue that 35 persons lost their lives during the floods across southern Ghana in June 2010 but a deeper investigation into the spatial distribution of fatalities reveals that as many as 18 deaths occurred in various settlements outside the Greater Accra Region.

The Accra metropolis is noted for the huge magnitude of displacement as a result of flooding. The displacement of 43,000 persons in the flood event of 26th October 2011 is unprecedented in the history of Ghana (UNEP/OCHA, 2011). The only comparable scale of displacement due to floods in Ghana occurred in the three northern regions in 2010. In 2010 heavy rains together with the opening of the spillway of the Bagre and Kampianga dams in Burkina Faso affected 332,548 persons in over forty rural and urban communities in the three northern regions of Ghana (UNEP/OCHA, 2011). A chronology of devastating floods in Ghana by Ahadze and Proverbs (2011) also establishes Accra as the modal town.

Households in Accra averagely, post higher incomes than those living in other settlements in Ghana; mean annual household income per capita for Accra is estimated at GH¢1,575 as against GH¢1,336 for other urban areas (Ghana Statistical

Service, 2008). The incidence of poverty in Accra as measured by the direct consumption (monetary) approach stood at 10.6% in 2006 (Ghana Statistical Service, 2008).

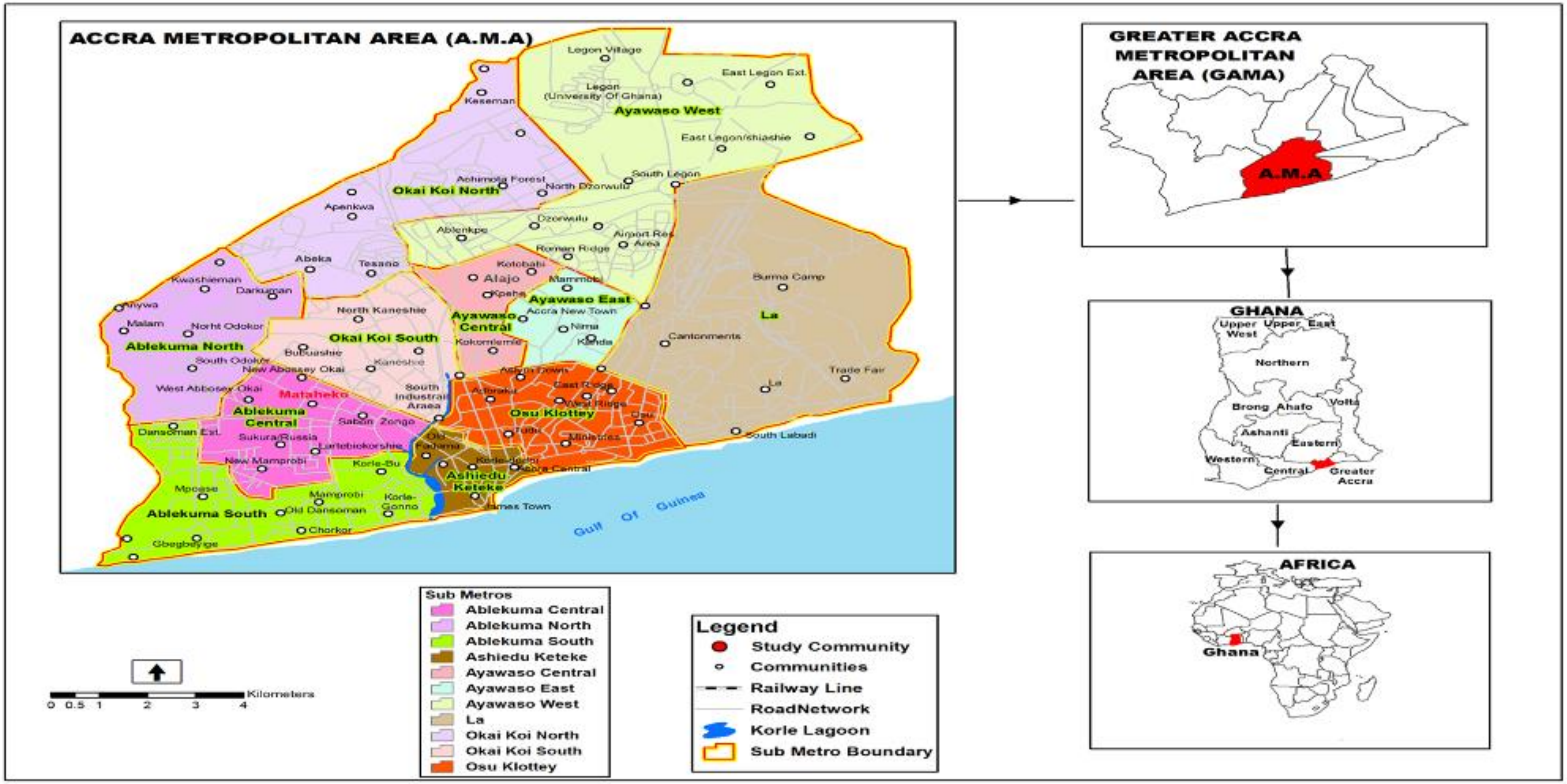
Direct consumption measures of poverty tend to underestimate urban poverty (Yankson and Owusu, 2007). Non-monetary measures of welfare establish the incidence of urban poverty firmly in the city of Accra ahead of other urban areas. Almost 60% of residents in the metropolis live in informal settlements and slums (Abraham et al. 2006). These areas are characterised by high densities, overstretched housing infrastructure and at times makeshift structures. Unemployment in the city (8.9%) is also higher than elsewhere in Ghana (national average of 3.6%), so is the proportion of households living in improvised homes (2.3%) which is more than 10 times higher than other urban settlements (0.1%) and rural areas (0.2%) in Ghana (Ghana Statistical Service, 2008). Poverty and urban decay are concentrated in high-density low-income enclaves of the city (Songsore et al. 2009; UNDP, 1992).

4.3 Profile of Accra Metropolitan Area

The Accra Metropolitan Area is located between longitude 0^0.03' and 0^0.15' west and latitude 5^0.30' and 5^0.53' North. Administratively, the city covers an area of 229 square kilometres (Abraham et al. 2006). The metropolis shares a common boundary with three municipalities in the north namely Ga East Municipality, Ga West Municipal Area and the newly created Ga Central Municipality. La Dadekotopon Municipal Area lies to the east whereas the Ga South Municipality is to the west of the Accra Metropolitan Area. In the south lies the Gulf of Guinea. The Accra Metropolitan Area and its neighbouring municipalities together with the Tema

Metropolitan Area, Ashiaman and La Kwatanang municipal areas define a functional city region, the Greater Accra Metropolitan Area (GAMA). Unless otherwise stated, Accra refers to the Accra Metropolitan Area. Figure 4.1 represents the Accra Metropolitan Area in the national and regional context.

Figure 4.1: Accra Metropolitan Area in the Regional Context



Population of Accra

The population of the Accra Metropolitan Area increased from 624,091 in 1970 to 969,195 in 1984 and then to 1,658,937 in 2000 (Ghana Statistical Service, 2002). Ghana Statistical Service (2012) puts the population of the Accra Metropolitan Area at 1,848,614 in 2010 of which 887,673 (48.02%) are males and the remaining 960,941 (51.02%) are females. The current population of the Accra metropolis accounts for 46.1% of the total population of the Greater Accra Region. The Accra Metropolitan Area experienced a bursting population growth of 7.5% per annum between 1970 and 1984 but this slowed down to 3.4% per annum between 1984 and 2000. Between 2000 and 2010, Accra grew slowly at a rate of 1.1% per annum.

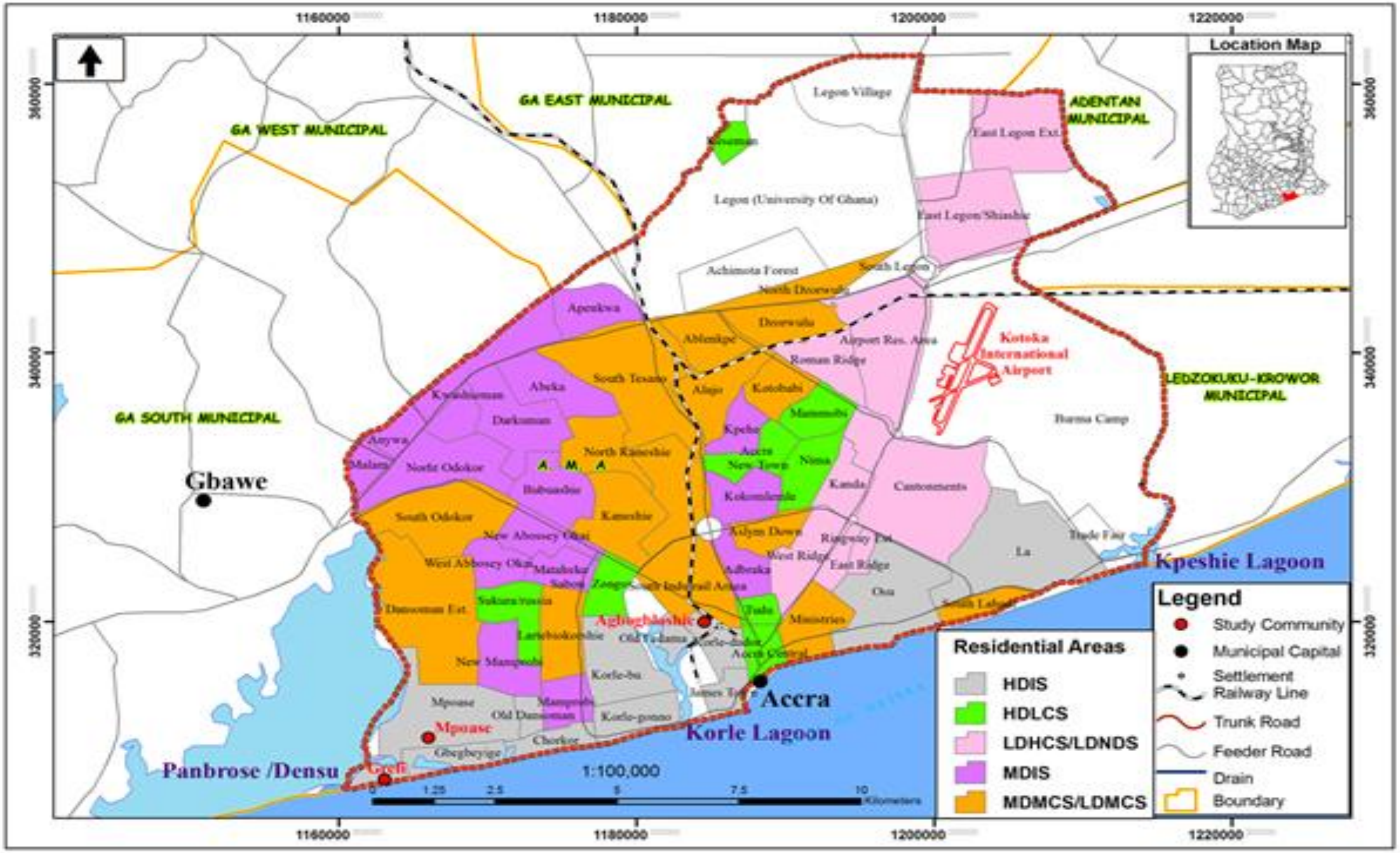
The declining trend in the growth rate of Accra is due to fixity of land in the metropolis but the hiving off of portions of the metropolis and constituting them into new municipalities has also affected population dynamics within the city. L.I.1926 of 2007, for example, created the La Dadekotopon and Ledzokuku Krowor municipalities out of the Accra Metropolitan Area. By this legislation, the Accra Metropolitan Area seeded off densely populated growth centres like Teshie and Nungua to new municipal areas. Hence the sharp decline in the population growth rate between 2000 and 2010. Nevertheless, the population of Accra more than doubled (increased by 196.2%) between 1970 and 2010 causing gross densities to rise from 6.23 per persons hectare in 1970 to 69.3 per hectare currently (UN-HABITAT, 2009; www.ama.ghanadistrict.gov.gh).

Residential Classification of Accra

Broadly, the Accra Metropolitan Area has three (3) residential classes namely the low, medium and high-income zones (UNDP, 1992). A number of studies and government documents (Government of Ghana, 2011; Songsore, et al. 2009; Songsore and McGranahan, 1993) have used this classification. According to this classification, the low-income zones are sub-divided into indigenous and low cost enclaves (Areas shaded grey and green in Figure 4.2 represent High Density Indigenous Sectors (HDIS) and the High Density Low Cost Sectors (HDLCS) respectively). These areas are heavily built-up with very little room for expansion, buildings are of poor quality and housing infrastructure like roads, and drains are underdeveloped. Noted for their informality, these high-density residential zones are attractive destinations for new migrants (UNDP, 1992). The poor in Accra tends to be concentrated in the high-density indigenous sectors (HDIS) and high-density low cost sectors (HDLS) where access to environmental services are generally poor (Amuzu and Lietmann, 1994).

In the middle-income areas of Accra, housing is of better quality compared to the high-density zones. UNDP (1992) divides this residential class into two; the medium class indigenous sector (MCIS) and the medium density middle-class sector (MDMCS). The high-income areas are well planned with superior housing infrastructure and modern architecture. Such areas consist of the low-density middle sector and the low-density high cost sectors. Housing development in the low-density medium sectors consists of estates developed by parastatals and government agencies like Social Security and National Insurance Trust (SSNIT). The high-density high cost sectors are Old European enclaves or areas inhabited by top civil servants and/or the 'nouvaux riche' (see Figure 4.2 for residential classification map of Accra).

Figure 4.2: Residential Classification Map of Accra



Climate of Accra

Accra lies within the West African sub region. The El Niño-Southern Oscillation (ENSO) and the movement of the Inter Tropical Convergence Front influence the climate of this region (Conway, 2008; Ofori-Sarpong and Annor, 2001). The El Niño-Southern Oscillation is responsible for drought conditions over the region whereas the movement of the Inter Tropical Convergence Front determines seasonality (Le Barbe´ et al. 2002; Ofori-Sarpong and Annor, 2001). Mean annual rainfall in Accra hovers around 800mm (μ=787.4mm; S.D =243.92) occurring mostly in fewer than 80 days but as indicated in Figure 4.3 and 4.4 annual rainfall and the number of rainy days have been exhibiting a declining trend since 1961.

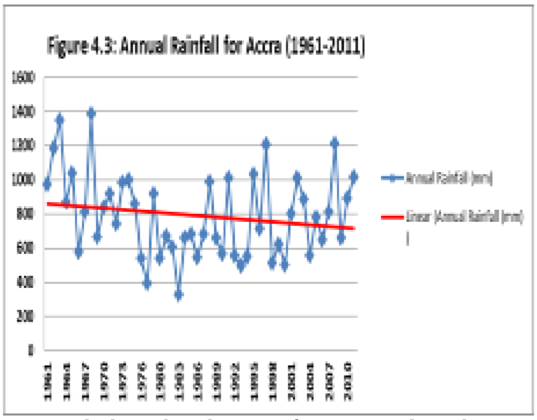


Figure 4.3: Annual Rainfall for Accra (1961-2011)

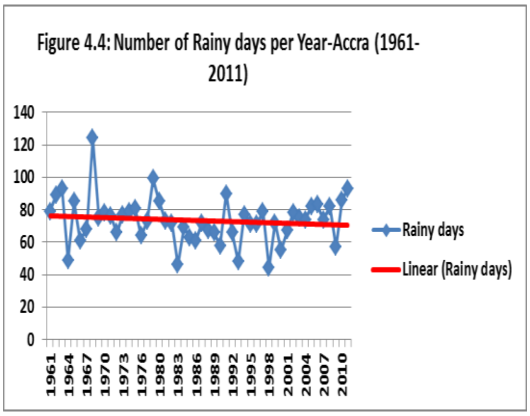
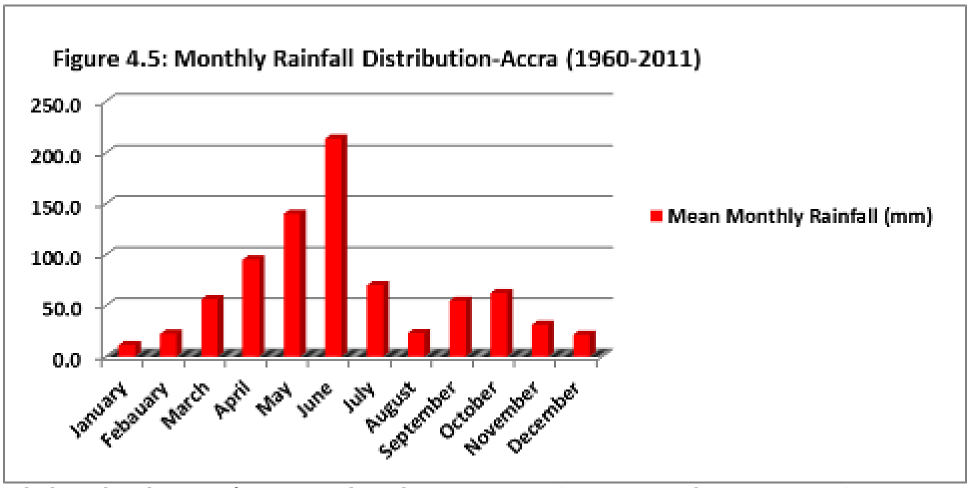


Figure 4.4: Number of Rainy days per Year-Accra (1961-2011)

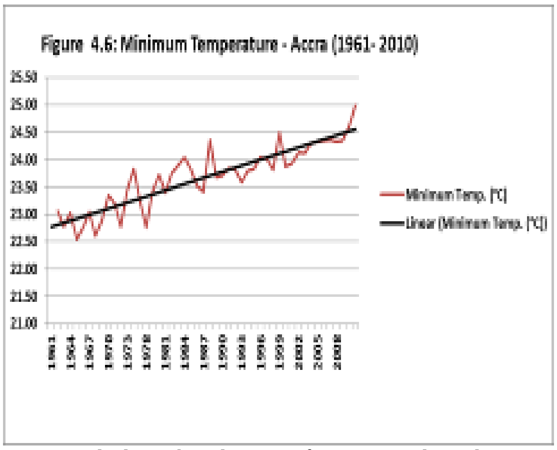
Source Calculation based on Data from Meteorological Service Agency, May 2012
Source data did not include values for 1976

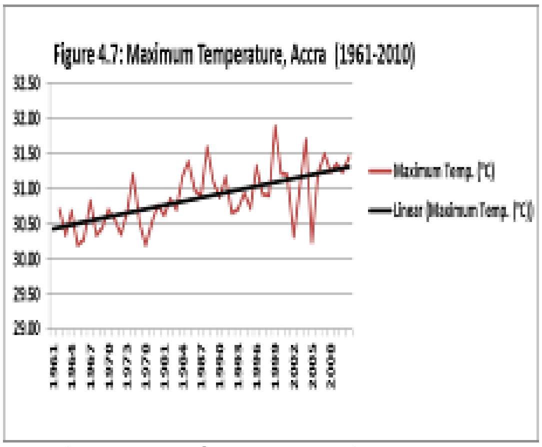
Accra is located within the coastal savannah ecological zone of Ghana. This zone is characterised by a double maxima (bi modal) rainfall regime and high temperatures (Songsore et al. 2009). The northward migration of the Inter Tropical Convergence Front from March to June draws in moist monsoon winds from the Atlantic Ocean bringing rain and storms to Accra. This period corresponds to the major rainy season when over 50% of the precipitation occurs (Songsore et al. 2009). Most of the heavy rainfall that results in flooding in the Accra metropolis and its environs occur during this period. Such rains are short lived and intense. The minor rainy season occurs between October and November, during the southward migration of the Inter Tropical Convergence Front. The dry season occurs between November and February. During this time, the dry northeast trade winds blowing from Sahara high-pressure zone dominates most of the West African sub region, spreading its influence up to the coast. The trade winds create dry and hazy conditions over Accra. Rainfall distribution in Accra over the past 50 years as presented in Figure 4.5 reflects this trend.



Calculation based on Data from Meteorological Service Agency (Mpeasem Weather Station-Accra), May 2012
*Source data did not include values for 1976

Temperatures are high all year round with daily variations higher than seasonal variations. The average monthly temperature range is around 4°C throughout the year. Diurnal temperatures range from 19°C to 32°C from December to June. Between July and November, the days are cooler and temperatures range from 18°C to 29°C (Songsore et al. 2009). Within this general picture, both minimum and maximum temperatures show a rising trend as indicated in Figure 4.6 and 4.7.





Source: Calculation based on Data from Meteorological Service Agency (Mpeasem Weather Station-Accra), May 2012
*Source data did not include values for 1976 and 1977

The emerging trend from Figure 4.3 and Figure 4.4 together with Figure 4.6 and Figure 4.7 is that of declining rainfall and rising temperature in Accra. This fits the picture of changing climatic conditions (climate variability) in Ghana (Agyeman-Bonsu et al. 2008; Conway, 2008).

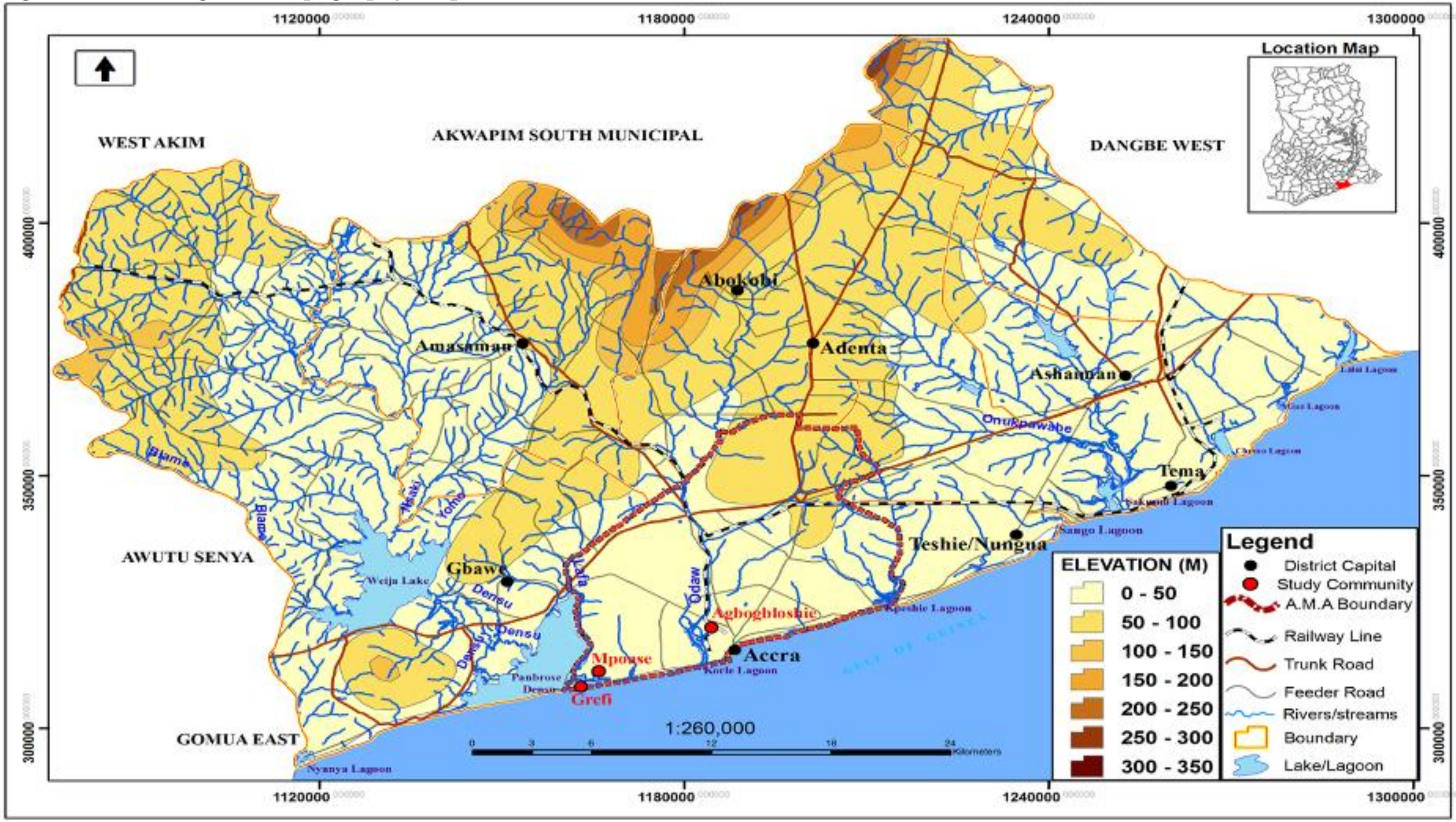
Topography and Drainage of Accra

The Accra Metropolitan Area is part of the coastal plains of Ghana, which stretches up to 80 kilometres west of the Volta River. The area is generally low-lying with isolated hills. The slope of the city is gentle below 11 per cent (Nyarko, 2002). The land slopes towards the Gulf of Guinea. The coastal zone of Accra is low-lying with mean elevation below 30 metres above mean sea level (Oteng-Ababio et al. 2011). North of Accra is the Akuapem-Togo-Atakora series, which runs diagonally in a northeast direction off the coast of Bortinor. The Fold Mountains act a watershed for the major rivers that drain Accra including the Lafa and Odaw rivers (UNDP, 1992).

There are four major drainage systems in the Accra Metropolitan Area (Nartey et al. 2012). The Densu River and Sakumo (I) Lagoon catchment covers settlements like, Dansoman, Kwashieman, McCarthy Hill and Awoshie areas. The Korle-Chemu catchment basin covers an area of 250 km^2. The Odaw River is the main river in this system with Nima, Onyasia, Dakobi and Ado as its tributaries. The Odaw catchment accommodates about 60% of the residents of the Accra Metropolitan Area (Abraham et al. 2006; UNDP, 1992). The Korle Lagoon lies in this catchment and it is the principal outlet of the Odaw River into Gulf of Guinea. The Kpeshie catchment covers an area of 110 km^2 and drains settlements like Cantonments, Osu, Labadi and Burma Camp. The Songo-Mokwe catchment covers about 50 km^2. Teshie is located within its catchment.

The major rivers that drain the Accra metropolis take their source from the Akuapem Mountains, flow in north-south direction into the Atlantic Ocean through a system of coastal lagoons with the prominent ones being Korle, Songo, Chemu, Gbugbe, Gyatakpo, Kpeshie and Klorte lagoon (UNDP, 1992). Only a few of the primary drains like the Odaw, Kaneshie, Korle-Gonno, Awudome and Kpehe have been engineered. A map illustrating the topography and river systems in the Greater Accra Metropolitan Area is presented as Figure 4.8.

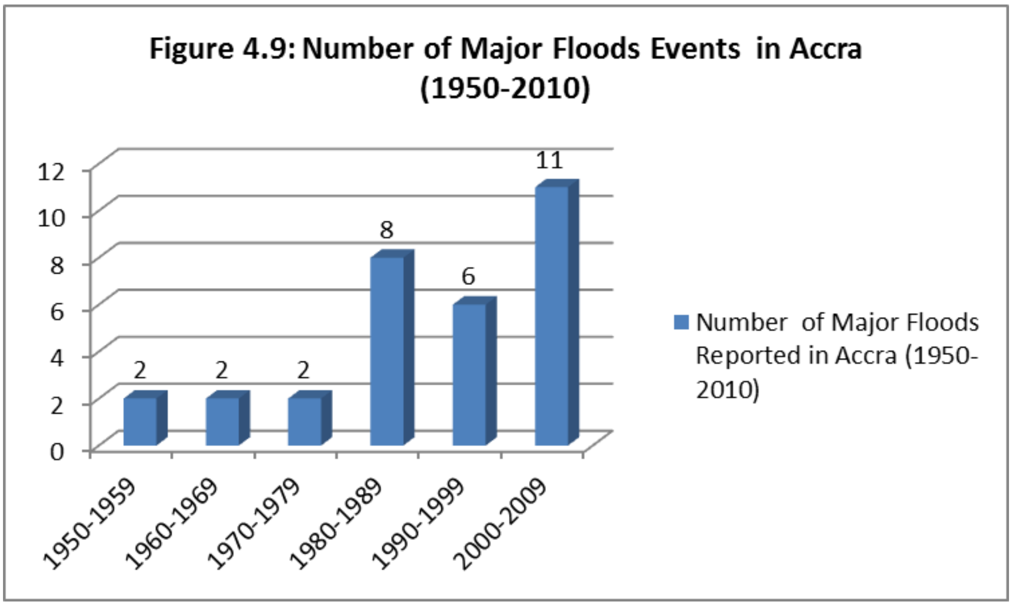
Figure 4.8: Drainage and Topography Map of Accra in the Context of GAMA



4.4 Trends in Accra's Major Flood Events

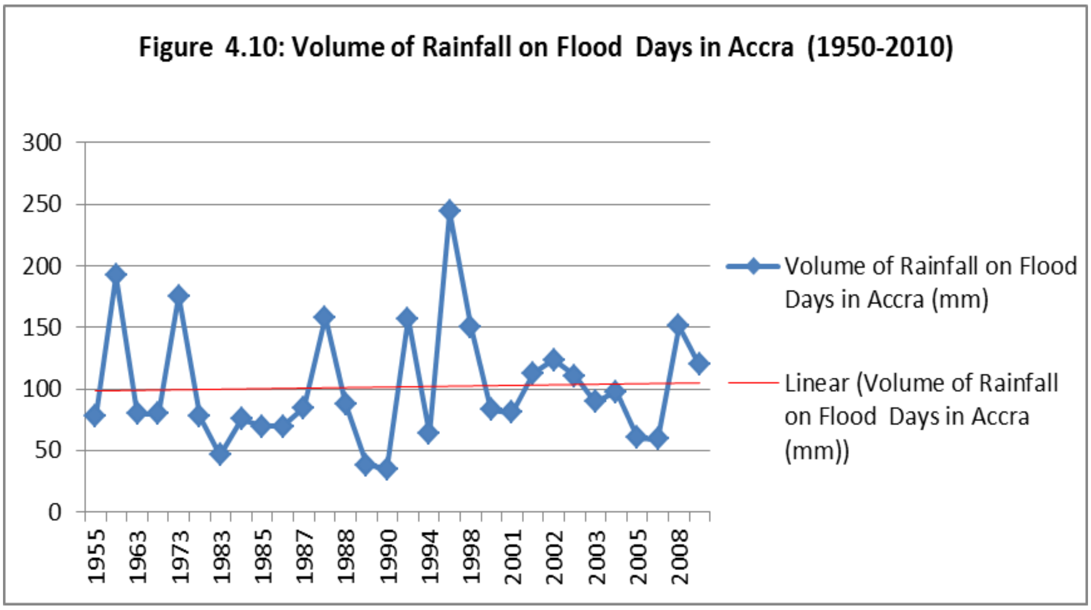
Data on flood depth, rainfall duration and intensity in Accra are either scattered or unavailable. Data on flood days in Accra are available in media reports, ad hoc disaster situational reports prepared by the National Disaster Management Organisation (NADMO) as well as in scholarly works. Data on intensity and rainfall volume are available from the Repository of the Ghana Meteorological Agency. Data from these sources are analysed to ascertain the pattern of floods in Accra.

Accra's susceptibility to floods has never being in question but the earliest record of a flood event in the city was in 1936 (Ahadze and Proverbs, 2011). The record failed to provide a vivid account of the event as in the date, duration, areas affected and damages as well as the volume and intensity of rainfall recorded. Adinku (1994) and Songsore et al. (2009) have also chronicled major flood events in Accra from 1950 to 1994 and between 1999 and 2006 respectively. Information on flood events in Accra between 1994 and 1999 and after 2006 are patchily presented in Aboagye (2012a) and UNDEP/OCHA (2011). The scientific sources were collaborated with media reports to provide a more comprehensive picture of the history of floods in the city of Accra. From the literature, Accra has experienced thirty-one (31) major floods since 1950 (see Figure 4.9). Appendix D represents a chronology of major flood events in Accra.



Source: Adinku (1994), Songsore et al. (2009), UNDEP/OCHA (2011) and Media Reports

Figure 4.9 reveals that the number of major flood events reported in Accra increased by 450% between 1950-1960 and 2000-2010. The rising trend in the number of major flood events per decade began in 1980. With the exception of the tidal wave attack in Glefe and its environs in 2010, all the major floods in the city have been occasioned by rainfall. Data available suggest that in general devastating floods in Accra have been preceded by rainfall events with intensity greater than 50mm/hr. except for the events of 27th May, 1978 and 6th January, 2002. This evidence is not enough to establish increasing rainfall intensity on flood days as a correlate of flooding in Accra. Further investigation into the role of rainfall intensity in flooding in Accra was hampered because data on rainfall intensity covering the periods 1985 to 1994 were not available from the Ghana Meteorological Agency. Data on the volume of rainfall preceding flooding in Accra were available from the Ghana Meteorological Agency and are presented in Figure 4.10.



Source: Based on Data from Meteorological Service Agency, May 2012

From Figure 4.10 an increasing trend in the volume of rainfall on flood days is established, a further analyses of the differences observed revealed that they were statistically significant at 10% ($F=2.380$; $p=0.068$). This suggests rainfall volumes on flood days are not very different from each other.

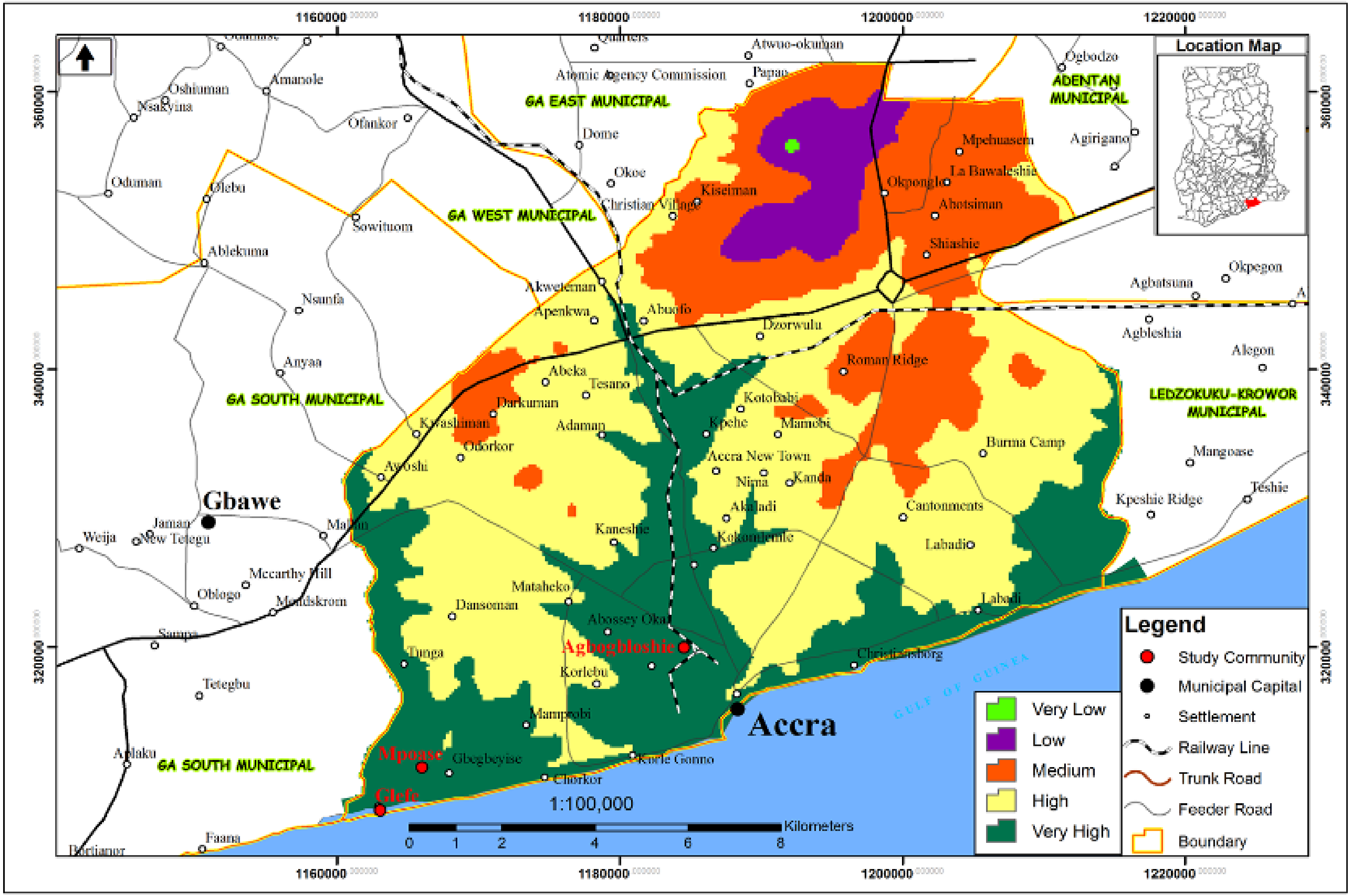
The geography of flooding in Accra has also changed since the 1950s. In the 1950s through to the 1970s flooding was concentrated in the Odaw catchment with Agbogbloshie, Kaneshie South and North Kaneshie experiencing devastating floods. In the 1980s and 1990s, communities like Nima, Kwame Nkrumah Circle, Obetsebi Lamptey Circle, Avenor and Aladjo entered the ranks of flood risk communities. More recently, areas like Dansoman Otorjor, Gbegbeysie, Panbros, Glefe and Mpoase that are within the Densu-Sakumo catchment have joined the league of notorious flood zones in Accra. The high-risk zones are concentrated along the coastal front and within the flood plains of the major rivers, which drains the city, notably the Odaw river (see Table 4.1 for flood prone communities in Accra and Figure 4.11 for a flood risk map of Accra).

Table 4.1: Flood Prone Communities in the Accra Metropolitan Area

Catchment	**Flood Prone Communities**
Densu-Sakumo	Mpoase Dansoman (Otorjor) Panbros Glefe Gbegbeysie*
Korle-Chemu	Sukura* Chorkor Agbogbloshie* Alajo Avenor Old Fadama* Abossey-Okai Kaneshie First Light North Kaneshie Nima Dzorwulu Kwame Nkrumah Circle Maamobi Caprice Mataheko
Kpeshie	La

Source: UNDP (1992), Adinku, (1994), Songsore et al. (2009) * ILGS and IWMI (2012)

Figure 4.11: Flood Risk Map of Accra Metropolitan Area



4.5 Research Design

In general, research design provides the framework within which the entire study is conceived and undertaken. This study has elements of both exploratory and cross-sectional designs. The elements of the exploratory research design were in-depth interviews, focus group discussions, secondary data collection and physical observations. Expert surveys using in-depth interviews were used to elicit information from heads and field operatives of public institutions mandated to undertake flood alleviation interventions in the Accra Metropolitan Area. Apart from these, physical observation, key informant surveys and focus group discussions were used at the community level to collect data from the community leaders and residents on the causes and adaptation to urban floods within the study areas. Data from these sources together with secondary data were reviewed and analysed qualitatively for consistency and their points of departure using content analyses.

Exploratory studies are suitable when the study boundaries are not clearly defined and knowledge about the research area is not well established as it allows for the incorporation of new ideas into the study (Sim and Wright, 2000; Sarantakos, 1998). However, such designs fall short when the research involves measurement or quantification of variables (Sim and Wright, 2000). A cross-sectional design was introduced to make up for this deficiency of exploratory research.

Cross-sectional designs allow for inference about a population at a point in time, but they are not applicable when trends are to be analysed (Frankfort-Nachmias and Nachmias, 1996). This design was used as the framework to investigate the determinants of household adaptation choices against urban floods and the correlates of household incidence of property damage due to floods as well as the extent of agreement among actors on the perceived causes of urban floods in Accra. Structured interviews were used to collect household data whereas regressions and correlations were the quantitative techniques used in the analyses.

4.5.1 Data Collection Methods

A qualitative approach was adopted to identify the institutions involved in public adaptation to floods in Accra and understand their actions and challenges. Qualitative data were obtained from organisations identified by ILGS and IWMI (2011), Karley (2009) and Afeku (2005) as the organisation involved in flood mitigation in Accra. These are; Town and Country Planning Department, Metropolitan Health Directorate, Metropolitan Roads Department, Waste Management Department, Environmental Health Department, Meteorological Service Agency and National Disaster Management Organisation (NADMO), Environmental Protection Agency as well as the Hydrological Service Department (Ministry of Water Resources, Works and Housing). Additional organisations were identified through snowball sampling. These were Water Resources Commission and the Drains Maintenance Unit of the Accra Metropolitan Assembly.

In-depth interviews were used to elicit information from officials of the above-mentioned organisations. The type of data collected included collaborating agencies and areas of collaboration, regulatory framework, existing and proposed projects, programmes and policies for flood alleviation in Accra. Other thematic areas of the in-depth interviews were causes of flooding in Accra and operational challenges. Key informants involved in major flood abatement projects implemented in Accra were also consulted for their perspectives. In comparison to structured interviews, in-depth interviews provide more detailed information about a phenomenon but it is prone to biases and the findings cannot be generalised across scale (Harries et al. 2011; Boyce and Naele, 2006). To augment the data from the in-depth interviews, secondary data on staff strength, annual expenditure and scope of adaptation measures were also collected.

Table 4.2: Organisations in the Accra Metropolitan Area Visited

Name of Organisation	Management	Operations
Town and Country Planning Department	1	N/A
National Disaster Management Organisation	1	2
Metropolitan Health Management Team	1	2
Environmental Health Department	1	N/A
Metropolitan Roads Department	1	N/A
Metropolitan Works Department	1	2
Drainage Maintenance Unit	1	N/A
Waste Management Department	1	N/A
Metropolitan Health Department	1	N/A
Environmental Protection Agency	1	N/A
Water Resources Commission	1	N/A
Meteorological Service Agency	1	N/A
Hydrological Services Department	1	N/A

Source: Author's Construct September 2014

A mini workshop was organised for the stakeholders listed in Table 4.2 together with community leaders (traditional authority, landlords/resident association executives and elected councillors). The objective was to understand how these formal institutions interacted with other actors outside the public domain (informal institutions) as well as to analyse the ensuing networks for their weaknesses. At the mini-workshop, network maps to illustrate the relationship among agencies involved in land use planning/zoning regulation and drainage improvement/river channel modification were sketched and analysed by the stakeholders using the approach by Schiffer and Hauck (2010).

For the community and household surveys, three depressed urban communities were selected in the Accra Metropolitan Area as the study communities. The selection of study communities was influenced by the study focus on urban poverty and flooding. Selected communities were therefore drawn from the pool of flood prone communities that exhibited high density-low income characteristics (ref. Figure 4.2 for residential classification and Table 4.1 for flood risk communities in Accra). From the list, three (3) communities were purposely selected to reflect the types of flooding observed in Accra; coastal, fluvial and pluvial flooding. The selected communities are Agbogbloshie, Glefe and Mpoase (see Figure 4.12 for the location of the study communities). While Agbogbloshie is located in the Odaw catchment, Glefe and Mpoase are within the Densu-Sakumo (I) catchment.

Figure 4.12: Locational Map of the Three Study Communities

Agbogbloshie was Ga settlement with residents tracing its existence before the 1960s (Codjoe et al. 2014). With the construction of the Agbogbloshie market, a regional market, the settlement has been transformed into a heterogeneous, densely populated community with a combination of wooden and permanent structures (Codjoe et al. 2014). It is bordered in the north by Graphic Road, in the south by Old Fadama a squatter community popularly referred to as Sodom and Gomorrah, west by the Odaw River/Korle Lagoon, and east by the Accra terminal of the Ghana Railway Corporation. The community is frequently flooded and has inadequate drainage. Access to in-house and yard plumping is low. Flooding is a major problem in the community (Codjoe et al. 2014). The population of Agbogbloshie was 8,305 in 2010.

Glefe is a suburb of Accra. The community sits on a two (2) kilometre long sand bar traversing Accra's west coast. Behind the sand bar are two lagoons, Gbugbe and Gyatakpo lagoons (Amoani et al. 2012). The lagoons act as boundaries between the community and Mpoase in the north. Gbegbeysie is to the east and Panbros Salt Manufacturing Ghana Limited's salt ponds are found west of the community. The Gulf of Guinea is south of Glefe. Glefe is a permanent heterogeneous community with Ga Dangmes and migrants notably Ewes and Akans. Glefe experiences coastal flooding and erosion (Addo and Adeyemi, 2013; Amoani et al. 2012; Appeaning-Addo et al. 2011; Oteng-Ababio et al. 2011). The community also experiences pluvial and fluvial flooding. In 2010, the population of Glefe was 8,738.

Mpoase is an indigenous Ga community located north of Glefe. The community share a boundary with Glefe in South and Dansoman Estate in the north. Gbegbeysie is to the east of the community while the Panbros Salt Manufacturing Limited concession and the Lafa tributary are to the west of the community. Neighbourhoods close to the Gyatakpo Lagoon and the Lafa River experience fluvial flooding. The population of the community was 13,450 in 2010 according to the 2010 Population and Housing Census.

As part of the data collection exercise at the community level, focus group discussions were held in each of the study communities. The discussions centred on the causes of flooding and community level flood adaptation measures. The type of flooding experienced in the community determined the number of meetings in each community.

Three (3) focus group discussions were initially organised in Glefe/Mpoase to reflect the different types of flooding experienced by households living in the two communities, that is fluvial, pluvial and coastal flooding. These discussions provided household experiences and an overview of all the types of flooding in the community. The final focus group discussion in Glefe brought together two (2) members from each of earlier groups and community leaders from Glefe and Mpoase. The community leaders consisted of representatives from traditional authority, the assembly member for Gbugbe Electoral Area, the chairperson and secretary of Glefe Development Association as well as three (3) women opinion leaders. There was one focus group meeting each in Mpoase and Agbogbloshie. The focus groups discussed and ranked the causes of flooding in their community.

One of the challenges associated with organising focus group discussions is the constitution of a group large enough to engender reasonable discussions without compromising the validity of the outcomes (Sarantakos, 1998). As a remedy to this dilemma, Sarantakos (1998) suggests that a group with membership around ten (10) is ideal whereas a group with more than 20 members becomes over bearing. All focus groups with the exception of the last one in Glefe/Mpoase consisted of 12 participants with between four to six women. In the final focus group discussion in Glefe/Mpoase, the number was increased to 15. This final focus group ranked the causes of flooding in the two communities and provided narratives to support their perceptions on the causes of flooding in their respective communities. Members of the focus groups have lived in the community for between ten (10) and sixty (60) years.

Another set of in-depth interviews at the community level were with officers of the Glefe Community Development Association and Agbogbloshie Landlords Association. These community-based organisations were mentioned during the community focus group discussions as being at the forefront of community adaptation to urban floods. Issues discussed with the executives of these associations included historical background, objectives, adaptation actions and challenges. The final in-depth interview was with an officer of Panbros Salt Manufacturing Limited, a large-scale salt processing company in the Densu Wetland. Community leaders in Glefe and Mpoase claimed that the activities of the company are a major cause of flooding in Glefe and Mpoase. The interview sought to bring their perspective on the causes and responses to flooding in the area into the study.

Quantitative methods were used to elicit data on household flood adaptation strategies and other micro level variables in each of the study communities. The target population were households living in areas liable to flood in the selected communities.

A multi-stage sampling approach was used to select samples at household level. As indicated earlier, the three study localities were selected purposively based on existing flood typology and settlement morphology. Community leaders helped with the identification and delineation of areas liable to flood in each of the selected communities. After mapping these areas with the help of a hand held Global Positioning System (GPS) machine, households within the flood zones in each of the study communities were listed. Proportionate samples were drawn from each of the selected enumeration areas using a simple random sampling to make up the desired sample size.

Compared to other sampling methods like simple random and systematic sampling, multi-stage sampling ensures that the selection of samples relate to research objectives. This sampling technique is also more cost effective compared to simple random and cluster sampling (Sarantakos, 1998).

Achieving reasonable level of precision and representativeness within given resource constraints is critical in surveying. To achieve a reasonable sample size, the formula in Miller and Brewer (2003) was adopted. This is summarised as:

$$n = N / (1 + (\alpha^2) N)$$

Where:

n = sample size

N = Total Population (Total Number of Households in the demarcated flood zone)

α = Margin of Error

Based on the formula, the appropriate sample sizes (n) for the three respective localities are presented in Table 4.3. In all 330 households were interviewed in this study.

Table 4.3: Appropriate Sample Size for Various Study Localities

Summary Parameters	**Glefe**	**Mpoase**	**Agbogbloshie**
Total Number of Households living in Flood Zones (N)	1,956	3,234	567
Margin of Error (α)	0.08	0.08	0.08
Sample Size (n)	101	169	60

Source: Author's Construct, June, 2013

Data captured from the structured questionnaire included household risk and adaptation appraisal, household socio-economic characteristics, household flood adaptation choices and household experience of property/asset damage or losses due to flooding (see Appendix A for sample household questionnaire). The data were used for estimating the correlates of household incidence of property damage due to flooding and household adaptation choices in the three selected communities. The household questionnaire also elicited data on household perception on the causes of flooding which were analysed together with the perceptions of other actors in flood adaptation in Accra for their level of agreement.

4.5.2 Data Editing and Analyses

The approach to analysing qualitative data followed the architecture laid out by Sarantakos (1998). This five (5) staged process began with data transcription from the recorder, cleaning/editing the transcripts and data reduction and detailed analyses. The other two stages involved generalising the findings of the individual interviews to highlight similarities and differences. Finally, there was verification of the results by going through the transcripts again personally and with the surveyed key informants.

For the quantitative data, upon checking of the field questionnaires for errors, they were entered onto the computer. Once the data were entered into the computer, the entries were checked again before analysing the data with the Statistical Package for Social Scientist (SPSS) and STATA. The analyses consisted of regressions, correlations and network maps as well as content analyses.

a. Network Maps for Institutional Analyses

The inter-agency challenges faced by institutions involved in flood abatement in Accra were analysed through Network Maps, which itself is a tool under social network analyses. Network maps are tools for mapping and measuring both formal and informal relationships among actors as well as providing insights into what facilitates or impedes flows among them (Serrat, 2010). Each organisation involved in an aspect of public adaptation to urban floods in Accra assumes the status of an actor in space (node). Lines represent the relationships (ties) between these actors. The ties between actors are manifestations of various power and knowledge domains accumulated through everyday life activities and institutional culture (Long, 1999).

Network Maps (Net-maps) is superior to organograms (organisational charts) in that the latter restricts institutional analyses to only formal actors and the networks among them (Scott, 1987). Network-Maps (Net-maps) are also simple to use as they provide a visual representation of power relations and flows within a system. This is a major strength of this tool as indicated by Schiffer and Hauck (2010) in a study of water management systems in the Volta Basin of Ghana. This notwithstanding, complex quantitative estimations like network density and centrality are not possible under Network maps.

b. Kendall's Coefficient of Concordance (W)

The Kendall's Coefficient of Concordance (W) is a statistical procedure used for identifying and ranking a given set of parameters in a descending order and subsequently measures the degree of agreement or disagreement among the parameters (Robinson, 1957). This study adopts this tool for analysing for the strength of convergence or differences in the perceived causes of flooding from the point of view of households, community representatives (leaders) and the heads of public institutions involved in flood adaptation in Accra.

In the computation of the total rank score for the perceived causes of flooding, the priority with the least score is ranked as the most important cause whilst the one with the highest score is ranked as the least important cause. The total ranked score computed is then used to calculate the Coefficient of Concordance (W), a measure of the degree of agreement in the rankings by actors.

The value of W lies between 0 and 1 ($0 \leq W \leq 1$). It assumes 1 when there is perfect agreement between actors on the perceived causes of flooding. When zero (0) it implies a perfect divergence between the groups on the causes of flooding.

If we let T represent the sum of ranks for each cause of flooding being ranked (e.g. inadequate drains, poor refuse collection and haphazard housing development), the variance of the sum of ranks is found by the formula:

$$Var_T = \frac{\sum T^2 - \left(\sum T\right)^2 / n}{n}$$

The maximum variance of T is then given by:

$$m^2\left(n^2 - 1\right)/12$$

The formula for the Coefficient of Concordance (W) is then given by:

$$W = \frac{(\sum T^2 - \left(\sum T\right)^2 / n)/n}{m^2\left(n^2 - 1\right)/12}$$

This simplifies to the computational formula for W as:

$$\frac{12\left[\sum T^2 - \left(\sum T\right)^2 / n\right]}{nm^2\left(n^2 - 1\right)}$$

Where; T = sum of ranks for each item being ranked,

m = number of rankings (experts, community heads and households),

n = the number of items being ranked (In this study n include inadequate drainage, housing development in water courses and poor refuse management).

The Coefficient of Concordance (W) was tested for significance in terms of the F-distribution. F test is a significance test used for comparing means of 3 or more samples/treatments, to avoid the error inherent in performing multiple *t*-tests. It involves the partitioning of the total variance into (1) variance associated with the different treatments/samples and (2) random variance, evidenced by the variability within the treatments.

An important assumption underlying the F test is that all treatments have similar variance**.** If there are strong reasons to doubt this, then the data might need transformation before the test. The *F* ratio can be computed from the ratio of the mean sum of squared deviations of each group's mean from the overall mean [weighted by the size of the group] ("Mean Square" for "between") and the mean sum of the squared deviations of each item from that item's group mean ("Mean Square" for "error"). If the calculated F value exceeds the tabulated value at a given degree of freedom, the null hypothesis (Ho) is rejected and the alternative hypothesis (H_1) accepted. On the other hand, if the F calculated is less than the tabulated value at a given degree of freedom, we accept the null hypothesis and reject the alternative hypothesis by default.

$$\textbf{F-ratio} = \frac{MST}{MSE} = \frac{SST\ (k-1)}{SSE/\ (n-k)}$$

Where,

MST = Mean of Square Treatment

MSE = Mean of Square Error

SSE = Sum of Square Error

k = Number of Treatments

n = Number of Observations

k - 1 = Degrees of freedom in numerator

c. Ordered Probit Regression Model for Estimating the Correlates of Household Flood Risk in the Study Communities

The study uses The Ordered Probit Model to estimate the predictors of household flood related property/asset damage or losses in the three study communities. Generally, logit, probit and tobit regression models provide a more accurate estimation of censored dependent variables compared to the ordinary least square approach. The ordinary least square approach under or over estimates censored dependent variables depending on the type of censored data (Greene, 1997:949). As the dependent variable, household report of property/asset damage during the first and/or latest flood event are continuous variables that are captured as ordered ordinal responses. Under such conditions, ordered logistic (logit/probit) regression is suitable for the analyses (Hedeker, 2002). The probit model is based on specification below:

$$y* = \beta' x_i + \varepsilon_i$$

With X_i being the regressors, β corresponding to the unknown vector parameters to be estimated with the first element being the intercept and ε the error term. The error term is logistically distributed with a mean (μ) of 0 and variance (σ) of $\pi^2/3$. The probability density function (pdf) and cumulative density function (cdf) are respectively presented below as:

$$\lambda(\varepsilon) = \frac{\exp(\varepsilon)}{[1+\exp(\varepsilon)]^2}; \text{ and}$$

$$\Lambda(\varepsilon) = \frac{\exp(\varepsilon)}{1+\exp(\varepsilon)}$$

For the latent variable y^* which maps on to an ordered observed y,

$y=m$ if $\tau_{m-1} \leq y_i^* < \tau_m$ for $m = 1, 2 \ldots.. j$

With τ's representing the thresholds. If the y* is continuous and related to the ordinal variable then the extreme categories will be $\tau = -\infty$ and $\tau_j = \infty$ (Long, 1997). For an ordinal dependent variable y_i with j categories,

$$
y_i = \begin{cases} 0 & \text{if } y \leq \tau_0 \\ 1 & \text{if } \tau_0 < y \leq \tau_1 \\ 2 & \text{if } \tau_1 < y \leq \tau_2 \\ \cdot & \\ \cdot & \\ \cdot & \\ J & \text{if } y > \tau\, j_{-1} \end{cases}
$$

<u>Empirical Model for Household Vulnerability to Property Damage from Floods</u>

As discussed earlier, vulnerability broadly involves exposure to risk, sensitivity and resilience (Turner et al. 2003). Exposure involves being prone to a hazard and its adverse consequences. Sensitivity covers the pre impact socio-economic status of the household while resilience is the ability to cope with or bounce back after the event (Braun and Aßheuer, 2011). This aspect of the study seeks to find out the physical context and socio-economic characteristics of households in the study communities that make them prone to flood risk as measured by household incidence of property/asset damage based on household first and/or latest flood experience. Sensitivity, exposure and implementation of private proactive precautionary measures are factors that influence flood risk at the household level (Braun and Aßheuer, 2011; Sagala, 2006; Kreibich et al. 2005).

Property/asset damage is a proxy for the direct consequences of flooding on households (flood risk) in this study. A direct cause-effect relationship can be established between the incidence of flooding in the study communities and loss of property/assets. Unlike injuries and drowning, the reported incidence of property/asset damage in the communities was high enough to merit the use of quantitative modelling techniques for the analyses.

From the ensuing discussion, the function below links vulnerability to property/asset damage from floods to social and physical vulnerability and household adaptation:

ProDam = f (Exp, Sen, Adapt)

Where:

ProDam = Property/asset damage from a flood event

Exp = Household factors of exposure to flood risk

Sens = Household sensitivity to flood risk

Adapt = Proactive Adaptation

The extent of property/asset damage in the study is determined by whether a household experienced property/asset damage during their first and/or latest encounter with floods or otherwise. Conceived in this manner, there will be households in the study communities who experienced property/asset damage from both the first and latest flood events (ProDam=0), those who experienced property/asset damage in one of the two events (ProDam=1) and finally, those who did not experience any damage or loss of property/assets in both events (ProDam=2). Logically, these ordinal ranks suggest that households who experienced property/asset damage/loss in either one of the two floods are worse off compared to those who experienced no property/asset damage/loss in both floods but they are better off than those who experienced property/asset damage and loss in both floods.

A number of scholarly works (Aboagye, 2012a; Sagala, 2006; Kreibich et al. 2005) provides insights to what constitutes household property/assets. For example, Sagala

(2006) in a study of physical vulnerability to floods in Naga City in the Philippines distinguished between building content and outside property. The former consisted of all household belongings like tools, appliances and furniture stored or located in-house whereas the latter are belongings kept outside the home. For the purpose of this study

Property/assets in flood adaptation studies consist of housing, durable personal effects, business structures, equipment, raw materials as well as finished and semi-finished products of local businesses (Aboagye, 2012a; Sagala, 2006). Therefore, if a household suffered damage to or lost any item in the categories enumerated above as a result of a flood event, then the household is deemed to have experienced property/asset damage in that particular flood event. The first and latest events are used as the reference points in the study because it was easier for the households surveyed to recall losses and damages from these two flood events.

The general conditions under which property/asset damage or loss occur due to the two flood events (first and latest flood event) is in the form:

Prob (event/occurs) =Prob (Y=j) = F [relevant effects: parameters]

Assuming a dependent variable with values 0, 1, and 2 for three ordinal responses above, which in this case represents:

i. Household experienced property/asset damage or loss in both first and latest flood events = **0**;
ii. Household experienced property/asset damage or loss in either first or latest flood events =**1**; and;

iii. Household experienced no property/asset damage or loss in both flood events=**2**.

The household discrete flood experience (property/asset damage) can be ordered into three categories namely P_1= P(y=1), $P_{2=}$P(y=2), P_3(y=3) for outcomes 0, 1 and 2 respectively. The parameters of the model are estimated using the maximum likelihood method.

The empirical model stated below is used to estimate the frequency of property/asset damage or losses resulting from household first and latest flood experience based on their locational and socio-economic profile.

$$\mathbf{ProDam} = \beta_0 + \beta_1\mathbf{Hosize}_i + \beta_2\mathbf{HHSex}_i + \beta_3\mathbf{Tens}_i + \beta_4\ \mathbf{PDrain}_i + \beta_5\mathbf{Windex}_i + \beta_6\mathbf{WDist}_i + \beta_7\mathbf{Elev}_i + \beta_8\mathbf{Educat}_i + \beta_9\mathbf{Lenst}_i + \beta_{10}\mathbf{DWallMat}_i + \beta_{11}\mathbf{D\ Adapt}_i \ldots\ldots\ldots + \varepsilon_{i.}$$

Where:

ProDam	= Property/asset damage from first or latest flood event
HoSize	= Household size
HHSex	= Gender of head of household
Tens	= Tenancy status of household
PDrain	= Presence of drain in front of home
Windex	= Wealth/asset Index of household
Educat	= Educational attainment of head of household
WDist	= Distance to the nearest water body
Elev	= Elevation of home
Lenst	= Length of stay in the community
DWallMat	= Type of wall material
DAdapt	= Household implementation of precautionary measures prior to latest flood event
β	= Parameter estimates
β_0	= Constant
ε	= Error term

Choice and Measurement of Variables

The variables used as regressors in the equation above were obtained from literature. These variables broadly represent factors of physical and socio-economic vulnerability. The variables are presented in Table 4.4 together with their means, description and a priori expectations.

Table 4.4: Description of Explanatory Variables for Ordered Probit Model

Variables	Description	Expected Sign	Means
Tens	Tenancy Status of Household (Landlord =1; Otherwise =0)	+	0.4909
HHSex	Sex of head of household (Female =1; Male=0)	-	0.3788
PDrain	Presence of concrete public drain in front of home (1= Yes; 0=No)	+	0.2485
Educat	Educational level of head of household (1= Above basic education; 0=Otherwise	+	0.3636
DWallMat	Type of wall material (1=Cement/Sandcrete; 0=Otherwise)	+	0.7939
Elev	Elevation of home above mean sea level (in metres)	+	10.1576
Wdist	Distance to the nearest water body (in metres)	+	236.02
HoSize	Household size (in number of persons in respondent's household)	-/+	4.7212
Windex	Asset Index	+	-5.25e-17
Lenst	Length of Stay in the community (in completed years)	+	13.2667
Dadapt	Household implemented a flood adaptation measure ahead of latest flood event (1=Yes; 0=No)	+	0.5006
LocalG	Community level dummy 1 (Glefe=1; 0=Others)		
LocalM	Community level dummy 2 (Mpoase=1; 0=Others)		
LocalA	Community level dummy 3 (Agbogbloshie=1; 0=Others)		

Source: Author's Construct

From Table 4.4 the independent variables can be grouped into socio-economic, physical and infrastructural. Social measures of vulnerability are household size (Hosize), sex of head of household (HHSex) tenancy status (Tens) and asset/wealth status of the household (Windex), educational attainment of head of household (Educat) as well as length of stay in the community (Lenst). With the exception of wealth status, which was estimated using Critical Component Analyses, the other socio-economic variables in Table 4.4 were directly obtained from questions in the household questionnaire (see sample questionnaire in Appendix A).

The expectation is that male-headed households, household heads with higher educational attainment and longer stay in the community would be less likely to report property/asset damage or loss from floods (Aboagye 2012a; Braun and Aßheuer, 2011).

Aboagye (2012a) notes that females in poor communities in Accra generally have lower access to education and employment opportunities and hence have a lower adaptive capacity, making them more vulnerable to the adverse impact of floods compared to males. Compared to recent migrants, indigenes and long-term migrants have better networks and so they will have better knowledge about flood and local site conditions. Households exhibiting these characteristics are generally less vulnerable to flood related damages (Aboagye, 2012a). Therefore, the expectation is that length of stay will have a positive effect on reducing the frequency of flood damages and losses. Household size is a measure of household density but it can expert either a positive or a negative influence on household experience of flood related property damage/loss.

Household asset/wealth (Windex) is used in place of income as a measure of financial capital. This is because the income variable is subject to either measurement or data collection errors, which can lead to an over or under estimation of the income variable. According to Braun and Aßheuer (2011) household income, in this case wealth quintile positively correlates with flood vulnerability reduction through access to better and more resilient housing and coping mechanisms. The asset index included household consumer durables like furniture, radio sets, refrigerator and television sets and livestock namely goats, sheep and fowls (see question G1 in the household questionnaire (Appendix A) for items considered in the construction of the asset index).

Elevation (Elev) and distance to the nearest water body (Wdist) are measures of physical vulnerability. Data on these two variables were collected using a hand held Global Positioning System (GPS) machine to estimate the distances of the homes surveyed from the sea, lagoon and river as the case may be as well as home elevation with respect to mean sea level. The literature suggest that the quality/type of building materials, distance to nearest water body and elevation also influence household susceptibility to flood damages. Homes built of sandcrete (cement), further away from water bodies and on higher elevation are more resilient than those built with mud, wood or landcrete, located at lower elevations and close to water bodies (Braun and Aßheuer, 2011; Sagala, 2006). Identification of household type of wall of material was through ocular inspection.

The presence of public lined drain in front of home (PDrain) is a measure of physical vulnerability and institutional responsiveness to the floods in the study communities.

The expectation is that presence of a public lined drain in front of the home will reduce household exposure to flood risk through improved storm water conveyance. Data on this variable were collected through ocular inspection.

Finally, household implementation of adaptation measures (DAdapt) is expected to minimise the adverse effect flooding on household property/assets (Kreibich et al. 2005). The private adaptation measures considered in the study are construction of retaining walls, raising doorsteps, construction of drains, cementing and filling of the compound, using sandbags as protective barriers, raising the foundation of kiosks and buildings as well as strengthening door and windows.

The Empirical Model for the Correlates of Household Adaptation Choices

In espousing the Protective Motivation Theory, Rodgers (1975) explains that primarily cognitive variables influence private adaptation choices through the stimulation of the protection motivation variable (intention to adapt). Grothmann and Patt (2005) and Lin et al. (2008) also show that both objective and subjective adaptive capacity variables influence adaptation choices at the micro level. Based on these, flood adaptation choices at the household level can be summarised into the functional form below:

Adpt = f (Obadpt, Subadapt)

Where:

Adpt = household implementation of a particular flood adaptation choices

Obadpt = household objective adaptive variables such as tenancy status

Subadapt = household subjective adaptive variables such as perceived like severity and perceived future occurrence of floods, Aboagye (2012a), Grothmann and Reusswig (2006) and Kreibech et al. (2005) have shown that some households residing in flood risk zones either implement proactive adaptation (precautionary) measures to protect life and property while others do not take any precautionary measures ahead of floods. The implication of this is that household adaptation choices can be viewed individually as discrete cases comprising of those who have failed to take any precautionary/protective actions (adaptation=0) or those who have undertaken some precautionary measures prior to a particular flood event to minimise the adverse effects on their household (adaptation=1). Binary logistic regression can be used to analyse the correlates of such dichotomous dependent variables (Leech et al. 2006).

In binary logistic regression, the categorical outcome variable Y_i ($i = 1,\ldots, n$) is assumed to follow a Bernoulli probability distribution which takes on two mutually exclusive outcomes: a value of one (1) with probability π_i and zero (0) with probability ($1-\pi_i$). Therefore, the probability of a household with a set of socio-economic and psychological characteristics (x) undertaking any adaptation (precautionary) measure (Y) prior to a flood event given a set available adaptation measures can be denoted as:

$$p(x) = E(Y/x), \text{ where } -\infty \leq x \leq \infty$$

Stated differently as:

$$\Pr(Y=1) = \pi_i$$

$$= \mathbf{1 + e^{zi}} \qquad \text{where } Z_i = \beta_1 + \beta_2 x_i$$

Similarly, the probability that a household under a set of socio-economic and physiological conditions does not take any precautionary (adaptation) measure prior to a flood event given the availability of adaptation strategies is denoted as 1-p(***x***) and can be simplified as:

$$Pr\,(Y=0) = 1-\pi_i$$

$$= \mathbf{1 + e^{-zi}} \qquad \text{where } Z_i = \beta_1 + \beta_2 x_i$$

The linear regression model cannot estimate the parameters Z*i* accurately in this case but the ratio of ($\pi_i/1-\pi_i$) can be used to achieve an estimate of the parameters in $\mathbf{Z_i}$.

This is the odds ratio and it is denoted as:

$$\frac{\pi_i}{1-\pi_i} = \frac{\mathbf{1 + e^{zi}}}{\mathbf{1 + e^{-zi}}} \qquad \text{where} \quad \mathbf{Z_i} = \beta_1 + \beta_2 x_i$$

The natural Log of the odd ratio is the logit model, which is an estimate of Z_i. This is denoted as:

$$\mathbf{Z_i = \mathit{In}\ [\pi_i/1-\pi_i\ ]} \qquad \text{where } Z_i = \beta_1 + \beta_2 x_i$$

The suitability of logistic regression for analyses of this nature lies in the fact that it requires fewer associations as compared to multiple regressions (Leech et al. 2005). In spite of its numerous advantages, logistic regression is not able to capture the hierarchy of the interrelationship between the dependent and independent variables.

<u>Specifying the Empirical Model</u>

The empirical model stated below is used to determine household flood adaptation choices given socio-economic conditions and a psychological evaluation of the situation.

$$\textbf{NoAdapt} = \beta_{0} + \beta_1\textbf{HHSex} + \beta_2\textbf{Tensh}_i + \beta_3\,\textbf{CLenst}_i + \beta_4\,\textbf{PDrains}_i + \beta_5\textbf{WStatus}_i$$
$$\beta_6\textbf{Pfoc}_i + \beta_7\textbf{Pfsev}_i + \beta_8\,\textbf{Papcost}_{i} + \beta_9\textbf{Affalab}_i + \beta_{10}\textbf{Adeffi}_i +$$
$$\beta_{11}\textbf{ProDam}_i + \beta_{12}\textbf{DWallMat} + \beta_{13}\textbf{Elevat} + \beta_{14}\textbf{Mast} + \beta_{15}\,\textbf{Educat} \ldots + \varepsilon$$

Where:

NoAdapt	= No Adaptation
HHSex	= Gender of head of household
Tensh	= Tenancy status of household
CLenst	= Length of stay in the community
PDrains	= Presence of public concrete drain in front of home
WStatus	= Wealth status
Pfoc	= Household perception on the future occurrence of floods
Pfsev	= Household perception on the future severity of floods
Papcost	= Perceived adaptation cost
Affalab	= Availability of family/friends be used as labour
Adeffi	= Perceived adaptation efficiency
ProDam	= Property/asset damage due to floods
DWalmat	= Type of wall material
Educat	= Educational attainment of head of household
Mast	= Marital status of head of household
Elevat	= Home elevation
β	= Parameters estimates
β_0	= Constant
ε	= Error term

Similar equations were derived to estimate the correlates of household choice of minor remedial works (AdaptSoft) and household choice of permanent concrete works (AdaptCont) ahead of the latest flood event using the same variables.

Choice and Measurement of Variables

The variables used as regressors in the empirical model were obtained from literature. These variables broadly represent both socio-economic and cognitive factors that influence household proactive adaptation choices. The variables are presented in Table 4.5 together with their means, description and a priori expectations.

Table 4.5: Description of Explanatory Variables for Logistic Regresssion Model

Variables	Description	Expected Sign*	Expected Sign**	Means
Tensh	Tenancy Status of Household (Landlord =1; Relative of Landlord=2;Tenant= 3; Perched = 4; 5 =Caretaker)	-/+	-/+	0.4909
SexHH	Sex of head of household (Female =1; Male=0)	-/+	+/-	0.3788
PDrain	Presence of public drain in front of home (1= Yes; 0=No)	-	+	0.2485
Educat	Educational level of head of household (Above basic education =1; Otherwise=0)	+	-	0.3636
DWallMat	Type of wall material (1=Cement; 0=Otherwise)	-	+	0.7939
CLenst	Length of stay in the community in completed years (5 years or More =1; 0=Less than 5 years)	+	-	13.267
Mast	Marital Status of Head of Household (1=Single 2=Married; 3= Others)	+/-	+/-	2.39
Elevat	Home elevation in metres above sea level (10 or more metres =1; Less than 10 metres = 0)	-	+	0.6
Pfoc	Perceived occurrence of floods in the next ten years (More=1; Same =2, Less =3 Do not know =4)	-	+	2.7303
Pfsev	Perceived severity of floods in the next ten years (More=1;Same =2; Less = 4; Do not know =4)	-	+	2.8030
WStatus	Wealth status Lowest Quintile =1; Second Quintile =2; Third Quintile =3; Fourth Quintile =4; Fifth Quintile =5	+	-	2.9667
Papcost	Household perception on adaptation cost (Expensive=1; Otherwise =2)	+	+	1.8333
Afflab	Availability of family and friends as labour for adaptation measures (Available =1; Not Available =0)	+	-	0.7181
Adeffi	Household believe that flooding can be minimised through local adaptation measures Don't Believe=1) (Believe=2;	+	-	1.7273
ProDam	Household experience of property damage Household report of property/asset damage more than once =1; Household report of property/asset damage once =2 No property damage reported =3	+	-	2.3333

***Adaptive responses are permanent concrete works (AdaptCont) and minor remedial works (AdaptSoft). **No Adaptation (NoAdapt)**

Data on variables in the Table 4.5 were captured using a structured questionnaire (see appendix A for sample questionnaire) but the variables were obtained from literature.

The asset base of a household together with its tenancy status (Tensh), length of stay in the community (Lenst) and sex of head of household (SexHH) are referred to as objective capacity variables (Grothmann and Patt, 2005). Others are home elevation (Elevat), marital status (Mast), type of wall material (DWallMat) and educational attainment of household head.

Grothmann and Reusswig (2006) suggest that high-income earners and the property owning class exhibit a higher propensity to adapt compared to low income earners, renters and other related tenancy. Therefore, the expectation is that tenancy status (Tensh) will have mixed effect on adaptation while income will exert a positive influence on adaptation. Wealth status (WStatus) is a proxy for income status. A asset/wealth index was constructed using Principal Component Analyses (CPA). After this, five wealth quintiles were generated. These are lowest quintile =1, second quintile = 2, third quintile =3, fourth quintile = 4 and highest quintile =5.

The expected sign for length of stay in the community (Lenst) is positive because it engenders social learning and comes with the accumulation of social capital. These are necessary for adaptation. The expected sign for sex of head of household (SexHH) is negative for adaptation and positive for no adaptation because female-headed households have a lower adaptive capacity than male counterparts (Aboagye, 2012a). The a priori expectation is that educational attainment of head of household (Educat) will have a positive effect on adaptation and negative on no adaptation. Education is also a source of knowledge; it may also enhance household income profile through better employment opportunities and hence provide resources for adaptation.

The subjective adaptive capacity variables are perceived probability of occurrence and adaptation appraisal. The variables that make up perceived probability of occurrence are perceived future occurrence (Pfoc) and perceived severity of future floods (Pfsev). These are measured by the household subjective estimate of the occurrence and severity of floods in the community in the next ten years compared to the current situation. Sub categories provided in the questionnaire are: 1= More, 2=Same, 3=Less and 4=I don’t know. Using the ‘more’ group as the reference group the a priori expectation is that households whose subjective estimation points to same flood occurrence and severity over the next ten years are likely not to implement any adaptation measure. Hence, the positive sign in Table 4.5. Generally, high levels of perceived severity and occurrence of flooding should associate positively with adaptive behaviour and negatively with no adaptation (Grothmann and Reusswig, 2006).

Adaptation appraisal measures considered in the study are perceived adaptation efficiency (Adeffi) and perceived adaptation cost (Papcost). According to Grothmann and Reusswig (2006) high subjective evaluation of adaptation appraisal engenders adaptive behaviour whereas a low evaluation facilitates mal or no adaptation (taking no precautionary measures ahead of floods). Availability of labour in the form family labour and labour from friends (Afflab) is used jointly as a surrogate for the existence of bonding social capital and self-efficacy in the model. For these three variables, categorical responses (yes or no and moderate or otherwise) were elicited from the households through the questionnaire.

Presence of a concrete (lined) public drain in front of home (PDrain) is a surrogate for public adaptation measures in the study localities. The literature indicate that when present, public adaptation measures do not engender private (household) adaptation (Grothmann and Reusswig, 2006). Thus, the expected sign for adaptation is negative and positive for no adaptation. The binary responses (Yes=1 and No=0) were obtained through ocular inspection of the frontage of homes of the survey respondents.

Property damage or loss (ProDam) measures household experience of property damage/loss due to floods (impact). It is expected to have a positive effect on adaptation while reducing the tendency not to adapt (Lin et al. 2008). The variable is recoded into three ordinal responses namely no property damage =3, household experience of property damage once =2 and more than once=1.

Home elevation (Elevat) is also a proxy for physical exposure to floods. Generally, households living at higher elevation including in storey buildings are less likely to adapt because they may be higher than the flood line. Therefore, home elevation will have a negative sign for adaptation and positive sign for no adaptation. A hand-held Global Positioning System (GPS) was used to measure home elevation. Data was captured in metres above mean sea level and later categorised into home elevation below 10 metres above mean sea level = 1 and elevations of 10 metres and above =2.

The dependent variables, household adaptation choices were obtained through the household questionnaire. The responses were confirmed by ocular inspection. The household adaptation choices are implementation of permanent concrete works (AdaptCont) and undertaking minor remedial measures (AdaptSoft) and no adaptation

(NoAdapt). Permanent concrete works consist of construction of retaining walls, filling and paving compounds and raising the platforms for kiosks ahead of the latest flood event. Minor remedial measures consist of using sandbags to protect homes, strengthening doors, windows and roofs as well as constructing earth drains ahead of the latest flood event. Finally, there were households who did not take any precautionary measures prior to the latest flood event (NoAdapt). For the dependent variable categorical response (1=Yes, 0=No) were elicited. The reference point was the latest flood event prior to the study on 9th December 2013. A general overview of the households surveyed is presented in Table 4.6 below.

Table 4.6 Summary Characteristics of Households Surveyed

	Locality Names						All Communities	
	Glefe N=101		Mpoase N=169		Agbogbloshie N=60			
Household Characteristics	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Sex of Head of Household								
Male	69	68.3	98	58.0	38	63.3	205	62.1
Female	32	31.7	71	42.0	22	36.7	125	37.9
Education Attainment of Head of Household								
No Education	16	15.8	13	7.7	14	23.3	43	13.0
Basic Education	56	55.4	80	47.3	31	51.7	167	50.6
Secondary Education	25	24.8	45	26.6	13	21.7	83	25.2
Tertiary	4	4.0	31	18.3	2	3.3	37	11.2
Household size (Persons)								
1	4	4.0	4	2.4	4	6.7	12	3.6
2	8	7.9	14	8.3	14	23.3	36	10.9
3	14	13.9	24	14.2	21	35.0	59	17.9
4	30	29.7	30	17.8	10	16.7	70	21.2
5	18	17.8	37	21.9	4	6.7	59	17.9
6	13	12.9	23	13.6	5	8.3	41	12.4
7 or More	14	13.9	37	21.9	2	3.3	53	16.1
Tenancy status of Households								
Landlord/lady	63	62.4	91	53.8	14	23.3	168	50.9
Relative of Landlord/lady	7	6.9	29	17.2	5	8.3	41	12.4
Tenants	28	27.7	43	25.4	38	63.3	109	33.0
Percher	1	1.0	2	1.2	3	5.0	6	1.8
Caretaker	2	2.0	4	2.4	0	0	6	1.8
Marital Status								

Never Married	10	10.0	15	9.1	7	1.7	32	9.8
Married	77	77.0	119	72.2	20	33.3	216	66.5
Consensual Union	2	2.0	5	3.0	13	21.7	20	6.2
Divorced/Separated	6	6.0	11	6.7	8	13.3	25	7.7
Length of Stay (in completed years)								
Less than 5years	34	33.7	34	20.1	15	25.0	83	25.2
5 years or More	67	66.3	135	79.9	45	75.0	247	74.8
Wealth Status								
Lowest Quintile	25	24.8	15	8.9	26	43.3	66	20.0
Second Lowest Quintile	27	26.7	23	13.6	16	26.7	66	20.0
Third Lowest Quintile	20	19.8	48	28.4	10	16.7	78	23.6
Fourth Quintile	15	14.9	35	20.7	4	6.7	54	16.4
Fifth Quintile	14	13.9	48	28.4	4	6.7	66	20.0
Drains in front of Home								
Yes	13	12.9	42	24.9	27	45.0	248	24.8
No	88	87.1	127	75.1	33	55.0	82	75.2
Wall Material								
Cement blocks/concrete	89	88.1	159	94.1	9	77.9	257	77.9
Mud/mud brick/earth	3	3.0	1	.6	0	1.2	4	1.2
Wood	7	6.9	8	4.7	50	19.7	65	19. 7
Metal sheet	1	1.0	0	0	1	0.6	2	0.6
Landcrete	1	1.0	0	0	0	0.3	1	0.3
Others	0	0.0	1	0.6	0	0.3	1	0.3
Distance to the Nearest Water body								
Less than 60 metres	28	27.7	34	20.1	0	0	62	18.8
60 metres or More	73	72.3	135	79.9	60	100	268	81.2
Home Elevation (at Mean Sea Level)								
Less than 10 metres	68	67.3	83	49.1	28	46.7	179	54.2
10-20 metres	33	32.7	86	50.9	31	51.7	150	45.5
More than 20 metres	0	0	0	0	1	1.7	1	0.3
Perceived Adaptation Cost								
Moderate	83	82.2	138	81.7	54	90.0	275	83.3
Expensive	18	17.8	31	18.3	6	10.0	55	16.7
Availability of Labour Support from Family and Friends								
Not Available	73	66.3	121	71.6	46	81.7	240	71.8
Available	28	33.7	48	28.4	14	18.3	90	28.2
Adaptation Efficacy								
Otherwise	73	72.3	121	71.6	46	76.7	240	72.7
Believe in Precautionary Measures	28	27.7	48	28.4	14	23.3	90	27.3
Perception on Occurrence of Future Flood								
More	42	41.6	69	40.8	30	50.0	141	42.7
Same	15	14.9	19	11.2	3	5.0	37	11.2
Less	7	6.9	43	25.4	21	35.0	71	21.5
Do not know	37	36.6	38	22.5	6	10.0	81	24.5
Perception of Severity of Future Floods								
More	50	49.5	68	40.2	25	41.7	143	43.3

Same	7	6.9	14	8.3	4	6.7	25	7.6
Less	5	5.0	40	23.7	25	41.7	70	21.2
I do not know	39	38.6	47	27.8	6	10.0	92	27.9

Source Author's Survey, January 2014

Table 4.6 presents data about the households surveyed in terms of basic demographic, physical and housing characteristics together with their perception on the future flood occurrence and severity as well as perceptions about adaptation measures. In terms of the demographics, 62.1% of the households' heads in the study communities were males compared to 37.9% females. The higher proportion of males reflects the national and Greater Accra Metropolitan Area patterns. According to Ghana Statistical Service (2014), 68.2% of all households' heads in Accra were males against 31.8% females. In a similar manner, 69.5% of all household heads in Ghana were males compared to 30.5% females.

In Ghana 19.7%, 44.6%, 20.9% and 14.7% of all persons above 15 years have no formal education, primary, vocational/junior/senior high and tertiary education respectively (Ghana Statistical Service, 2014). This does not compare favourably with the outcomes of the study in which 13%, 50.6%, 25.5% and 11.2% had no formal education, primary, JHS/ Vocational and senior secondary and tertiary education respectively. The study areas have a slightly better educational attainment than the national situation. This may be because the national figures are adversely affected by the presence of rural communities where educational attainment is low.

Mean household size among the study communities was 4.7 persons per household with the community breakdown being 3.3, 4.7, and 5.7 persons per household for Agbogbloshie, Glefe, and Mpoase respectively. These figures are higher than the metropolitan average of 3.4 persons per household and the national urban figure of 3.6 persons per household (Ghana Statistical Service, 2014). The high household size recorded in the study communities is a signal of high housing and population densities. The high household size can be attributed the large indigenous Ga Dangme population in Mpoase and Glefe. The distribution of household size is presented in Table 4.6.

Most of the household surveyed are homeowners. Landlords/ladies constituted 50.9% of the households surveyed with higher proportions reported in Glefe (62.4%) and Mpoase (53.8%) which had larger proportion of indigenous Ga Dangme. In Glefe and Mpoase, the proportion of Ga Dangme was 25.8% and 32.3% respectively, compared to 21.1% in Agbogbloshie. Tenants accounted for a third of the households surveyed (33%) but there were more renters in Agbogbloshie (63.3%) than in Glefe (27.7%) and Mpoase (25.4%). Comparatively, 35.2% and 32.8% of all households in the Greater Accra Metropolitan Area (GAMA) and urban Ghana respectively live in their own houses while 41% and 39.9% respectively rent houses (Ghana Statistical Service, 2014).

The high owner occupancy observed in the study communities is a feature of spontaneous housing areas. These informal settlements normally grow by accretion outside the formal planning system (Gilbert and Gugler, 1982). Apart from these, rent-free occupants accounted for 12.4% of the surveyed households compared to 23.1% and 26.8% for the Greater Accra Metropolitan Area and urban Ghana respectively (Ghana Statistical Service, 2014). Another 0.5% and 0.3% of the households in the Greater Accra Metropolitan Area and urban Ghana were perchers as against 1.8% in the study communities.

Overwhelmingly, cement (sandcrete) buildings dominate the architectural landscape of urban Ghana and the Greater Accra Metropolitan Area. This is captured in the 6th Round of the Ghana Living Standards Survey (Ghana Statistical Service, 2014). The survey reports that 91.5% and 85.3% of the houses in the Greater Accra Metropolitan Area and urban areas in Ghana respectively had outer walls fabricated with cement. The proportion reported in the study communities (77.9%) was lower than the Accra and urban figure for Ghana. In comparison, the proportion of shacks/wooden structures (19.7%) in the housing mix of the study communities was more than three times what pertains in the Greater Accra Metropolitan Area (6.5%). The proportion reported in the study communities was also more than eight times the situation in urban Ghana (2.5%). This is a clear indication that the incidence of urban poverty in the study communities is higher, compared to Accra and other urban communities in Ghana.

CHAPTER FIVE

A COMPARATIVE ANALYSIS OF PERCEPTIONS ON THE CAUSES OF FLOODING IN POOR COMMUNITIES IN ACCRA

5.1 Introduction

Several factors account for flooding in Accra. These factors are physical, social as well as institutional (Abraham et al. 2006). This chapter is a discussion on the causes of flooding from the scientific literature and then from the perspective of the key actors involved in the implementation of flood adaptation measures in the city. More importantly, the causes provided by the various actors are ranked and analysed for their levels of agreement or otherwise. The objective is to ascertain the veracity of the assertion by Arce and Long (1992) and Hilhorst (2013) that knowledge is socially constructed and context/actor specific. Apart from this, a clear understanding of the causes of flooding is important when taking remedial actions to reduce flood risks. This is because adaptation actions conceived without an understanding of the causes of flooding can be maladaptive, increase flood risk (Lebel et al. 2009).

5.2 Actors in Flood Adaptation in Accra

Some formal organisations are mandated to undertake flood adaptation actions as part of their legislative functions in Accra. They are mostly departments under the Accra Metropolitan Assembly. The organisations are Metropolitan National Disaster Management Organisation, Metropolitan Planning Department, Metropolitan Roads Department, Metropolitan Waste Management Department, Metropolitan Health Directorate, Metropolitan Public Health Department, Metropolitan Works Department and Drains Maintenance Unit. A few others are outside the local government structure, namely Hydrological Services Department and the Ghana Meteorological Agency. Officials in these agencies are referred to as technocrats or experts for the purpose of this study.

In addition to the public organisations mentioned above, a number of informal actors also play various roles in flood adaptation in the city. These actors are not mandated by any legislation to undertake flood adaptation measures yet their actions and activities influence public adaptation outcomes within the city. They include Members of Parliament (MPs), the Traditional Authority, Elected Councillors (assemblymen/women), and Community Based Organisations. Collectively, these agents are referred to as community or opinion leaders in this study.

5.3 Causes of Flooding in Accra: Results from Scientific Research

Several accounts have been provided in the literature to explain the perennial flooding in Accra. The factors largely reflect the physical characteristics of the city as well as demographic and land use changes that have occurred within the city and the wider Greater Accra Metropolitan Area. Some scholars have also cited government policies and rigidities in the provision of municipal services as the cause of flooding in the city. The documented causes of flooding in Accra are as follows:

Rainfall Characteristics

Heavy rainfall remains the most important cause of flooding worldwide (Few, 2003) and Accra is no exception. Data from the Ghana Meteorological Agency suggest that flooding in Accra has been associated with rainfall with intensities greater than 50 mm/hr and volumes as low as 59mm. Analyses of rainfall volumes on major flood days in Accra showed an upward trend but the differences in the rainfall volumes on flood days was statistically significant at 10%. This indicates that increase in the volume rainfall may just be one of the contributory factors to flooding in the city. Also important is the duration of rainfall. Aboagye (2012a) reports that the July 1995 flood in Accra was occasioned by 5 hours of heavy downpour in the city.

Accra lies in the coastal savannah ecological zone and characteristically experiences bi modal or double maxima rainfall (Songsore et al. 2009). Broadly, Accra's rainfall pattern has remained relatively stable since 1901 (Ofori-Sarpong and Annor, 2001). Average rainy days per year have varied between 66 days (1981-1990) and 82 days (1961-1970). Annual rainfall volumes hover around 800mm (μ=787 and S.D. =243.92). Seasonal patterns have remained stable with the rainy season peaking between May and July (Songsore et al. 2009; Ofori-Sarpong and Annor, 2001). Most of the flood events in the city occur within this period (Songsore et al. 2009). This notwithstanding, Agyeman-Bonsu et al. (2008) have predicted that annual rainfall in the coastal savannah belt, where Accra is located, will decline by 1.1%, and 20.5% in 2020 and 2080 respectively and its bi modal regime will ultimately be replaced by a uni-modal one.

Aside the projected declines in annual rainfall and variation in seasonal patterns, more flood events are likely to occur in Accra. For instance, Kwaku and Duke (2007) predict more heavy rainfall events for Accra. In their prediction, a maximum of 84.05 mm in 1 day, 91.60 mm in 2 days, 100.40 mm in 3 days, 105.67 mm in 4 days and 109.47 mm in 5 days is likely to occur in Accra every two years. Similarly, a maximum rainfall of 230.97mm, 240.49, 272.77mm, 292.07mm, and 296.54mm is expected to occur in 1, 2, 3, 4 and 5 days respectively every 100 years. Increase in heavy precipitation events cause flooding in the city, all things being equal.

Hydrology and Topography

Most of the rivers that drain the city of Accra like the Odaw and Lafa have their watersheds in the Akuapem Mountains (UNDP, 1992). These fold mountains are part of the Akuapem-Togo-Atakora series with an elevation ranging between 341 and 487.7 metres above sea level (Dodoo et al. 2011; Dickson and Benneh, 1970). The rivers in their youthful stage flow down the mountains swiftly into Accra, which is low-lying and gently sloping. The coastal front has elevations below 30 metres above sea level while its gradient averages 11% (Oteng-Ababio et al. 2011; Nyarko, 2002). The gently sloping terrain of Accra reduces the discharge velocity of the rivers into the sea (Nyarko, 2002).

Topography (elevation) is a determinant of flooding in Accra. Nyarko (2000:1045) in a study to delineate flood zones in Accra notes: "discharge concentration values determined from the arithmetic map overlay decreases as elevation decreases, indicating a slow runoff rate that has the potential of creating a backwater effect and generating flooding." This indicates that topography influences flooding. In the case of Accra, flooding can occur as result of heavy rainfall on the Akuapem Ridge flooding can occur in Accra.

Accra's Low-lying Open Coastline and Coastal Flooding

The nature of Accra's coastal front makes it susceptible to coastal flooding from storm surges and tidal wave attacks due to sea level rise (De- Graft, 2011). Accra has a relatively open coast that faces approximately 250 degrees (south-west). It is about 40 kilometres long. The unique orientation of the shoreline (approximately east-west direction) enables incident waves to break obliquely and generate long shore currents that facilitate littoral drift, while sea level rise influences tidal current effectiveness (Oteng-Ababio et al. 2011).

Based on its geomorphology the coastal zone of Accra is divided into three portions. The sections are western, central, and eastern portions. The western portion consists of a mixture of unconsolidated and poorly consolidated sediments. The central portion is made up of soft sandstone layers while hard rocks overlain with soft rocks make up the eastern portion (Appeaning-Addo, 2009). The western section tends to be more vulnerable to coastal erosion because of the presence of poorly consolidated materials.

The coastal zone of Accra is experiencing erosion. According to Appeaning-Addo (2009), about 82% of Accra's coastline is experiencing erosion at an average rate of 1.13 m/yr. ± 0.17 m. The western and the eastern parts are eroding faster (-1.7 and-1.9 m/yr. respectively) than central part which is eroding at a rate of -0.2 m/yr. Coastal erosion occurs as a result of natural processes namely; wave action, currents and sea level rise (Appeaning-Addo, 2009).

Anthropogenic activities have also made a significant contribution to coastal erosion in Accra (Addo and Adeyemi, 2013; Oteng-Ababio et al. 2011; Appeaning-Addo, 2009; Mensah, 1997). Human factors account for 70-90% of coastal erosion in Ghana, Accra inclusive (ACOPS, 2003). The dominant anthropogenic factors influencing coastal erosion in Accra are infrastructure development (Weija Dam, Accra Harbour and Tema Harbour), beach sanding mining (especially in the western section) and unplanned settlement development along the coast. These activities have created imbalances in the sediment budget and weakened the ability of the coastal rocks to withstand wave attacks (Appeaning-Addo, 2009).

Coastal erosion has reduced the mean elevation of Accra's fragile coastline. Coastal elevation of Accra is up to 4 metres above mean sea level (Addo and Adeyemi, 2013) though areas along the western portion record elevations as low as between 0.30 and 0.48 metres above mean sea level. The low elevated open coastline allows considerably strong, unimpeded swell waves to reach the shore (Appeaning Addo, 2009). This, coupled with sea level rise and an occasional storm surges, have heightened the vulnerability of Accra to coastal flooding. Estimated sea level rise in Ghana is at rate of about 2 mm/yr (Appeaning-Addo, 2009).

The significant wave height for 50% of the time is about 1.4 m, the period is between 10s and 15s, whilst spring high tide is about 1.26m high (AESC, 1980). The storm surges are created by sudden changes in wind intensity in the Atlantic Ocean, which pushes the seawater inland, and results in flooding (ScienceDaily, 2008). The combined effects of these processes place the coastal zone of Accra at risk from coastal floods.

Uncontrolled Urbanisation and Changes in Land uses

Urbanisation and land cover changes also cause flooding in Accra. The Accra Metropolitan Area is the nerve centre of a functional city region referred to as the Greater Accra Metropolitan Area. Ghana Statistical Service (2012) estimates that the total population of Accra is 1,848,614[2] with an annual growth rate of 1.1% per annum. From the literature, much of Accra's growth occurred between 1984 and 2000, the adjustment period, largely because of rural-urban migration (Grant, 2006). Accra's population increased from 969,195 to 1,658,937 between 1984 and 2000 with annual growth rate of 3.4% (Ghana Statistical Service, 2002).

With such a bursting population growth and the carving out of new municipalities from its original land mass, the population density of Accra increased more than tenfold from 6.23 in 1970 to almost 70 person per hectare in 2004 (www.ama.ghanadistrict.gov.gh). Population has not been evenly distributed across residential areas within the city. The low-income high-density zones, which constitute 50% of the city's total land area, have reported densities between 36,281 and 81,700 persons per km^2 as against 6,400-11,900 persons per km^2 for the high cost sectors (Adank et al. 2011).

The rising population has created a spurring demand for land for residential and other uses. To meet the rising demand for land in the city, uncontrolled conversion of non-residential lands into residential and other ancillary uses have occurred (Weeks et al.

[2] Although official statistics put Accra's population at 1,848,614 in 2010 some scholars including Karley (2009) hold the view that Accra's population is actually around 3 million especially during the day. Official statistics are based on the new boundary of the Accra Metropolitan Area established in 2008.

2012; Otoo et al. 2006). For instance, the built up area of the Accra Metropolitan Area increased by 6.6% between 1985 and 2000 (Otoo et al. 2006). As buildable land is virtually unavailable within the city, reclamation of nature reserves together with the annexation of open spaces within the residential milieu have been the major sources of increasing the supply of land for residential development in the city (Afeku, 2005). These practises have become perverse in flood prone and other eco-fragile zones in the city. The encroachments create conditions for fluvial and ponding in the city because they obstruct run off as well as storm water conveyance and decrease the storage capacity of coastal lagoons and other water bodies (Rain et al. 2011).

Land use changes due to urbanisation also increases the area of impervious surfaces within the city. Impervious surfaces reduce infiltration and run off time in addition to increasing discharge velocities into drainage systems. The drainage systems are overloaded quickly once it rains leading to flooding (Rain et al. 2011; Andjelkovic, 2001). The run off co-efficient of the Upper and Lower Odaw catchment were 0.6 and 0.9 respectively whereas that of the Lower and Upper Densu catchments were 0.4 and 0.6 respectively (Nyarko, 2000).

The catchment communities of the Upper Odaw including Achimota are either peri-urban or medium density residential areas. These communities are not as populous as the typical slums like Old Fadama and Agbogbloshie and mixed commercial-residential zones that make up the lower Odaw catchment. These explain the higher runoff co-efficient for the Lower Odaw catchment and its propensity to overflow its banks leading to flooding of adjoining land areas.

Poor Solid Waste Management

Poor solid waste management has also contributed to flooding in Accra. The city with a population of 1,848,614 and currently growing an annual rate of 1.1% generates almost 2,000 metric tonnes of municipal waste per day (Adamptey et al. 2009; Nartey et al. 2012). This is a 25% increase over the 1,600 tonnes per day quantity reported in the early 1990s (Benneh, 1994). Of this quantity, 25%-33% remains uncollected. The uncollected municipal waste ends up in open drains, coastal lagoons and river systems (Nartey et al. 2012; Boadi and Kuntinen, 2002; Lamptey and Abban, 1999). The waste clogs these systems and/or reduces their storage capacity leading to flooding during rains.

Nyarko (2000) estimates that the storage co-efficient of the Upper Odaw and Densu systems as 0.7. However, by the time these rivers reach their lower courses their storage co-efficient have declined to 0.2 and 0.6 respectively. The reduction in the storage co-efficient between the youthful and matured stages of these rivers is partly explained by cumulative siltation and sedimentation, which manifest at lower course of these rivers. In addition, the lower courses of the two rivers are characterised by a concentration of light industrial activities and low-income residential areas. These land uses have a high propensity for waste generation and open dumping (Abraham et al. 2006). South Industrial Area and slums like Agbogbloshie, Adabraka Sahara (Odawnaa) and Old Fadama (Sodom and Gomorrah) are all located within the catchment of the Lower Odaw.

<u>Underdeveloped Drainage Network in Accra</u>

Another cause of flooding in Accra as discussed in the scientific literature is the underdeveloped drainage systems characterised by design flaws in the storm drain network and unlined secondary and tertiary drains (Karley, 2009; Twumasi and Asomani-Boateng, 2002). Karley (2009) for example notes some of the design flaws associated with Accra's drainage network as undersized drains and culverts as well as lack of access ways for small rivers to enter the main drains.

5.4 Actor Perspectives on the Causes of Flooding in Accra

The causes of flooding in the various communities are presented in Table 5.1. These perspectives were obtained from 330 households and 27 community leaders in the three study communities as well as senior technocrats in 13 public organisations involved in flood adaptation in Accra.

Table 5.1: Opinions on the Causes of Flooding in the Study Communities by Actors

Causes of Flooding	Technocrats in AMA		Households						Community Leaders			
			Glefe		Mpoase		Agbogbloshie		Glefe/ Mpoase		Agbogbloshie	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Act of God	0	**9th**	53	**7th**	9	**8th**	8	**7th**	1	**8th**	1	**7th**
Settlement in Flood Zone	17	**3rd**	67	**4th**	45	**6th**	18	**5th**	22	**1st**	4	**5th**
Heavy Rains	5	**6th**	112	**2nd**	184	**2nd**	97	**2nd**	4	**7**	3	**6th**
Poor Planning	3	**7th**	120	**1st**	144	**3rd**	62	**3rd**	6	**5th**	17	**1st**
Poor Drainage	21	**1st**	68	**3rd**	249	**1st**	113	**1st**	7	**4th**	11	**3rd**
Drainage Problems Elsewhere	5	**4th**	61	**5th**	128	**4th**	22	**4th**	13	**3rd**	16	**2nd**
Natural Resources Exploitation	5	**5th**	59	**6th**	49	**5th**	0	**9th**	17	**2nd**	0	**8th**
Poor Refuse Management	18	**2nd**	32	**8th**	26	**7th**	12	**6th**	5	**6th**	5	**4th**
Other Causes	1	**8th**	17	**9th**	6	**9th**	7	**8th**	3	**9th**	0	**9th**

Source: Household Survey and Focus Group Discussions with Opinion Leaders in Mpoase, Glefe and Agbogbloshie, Institutional Survey with 13 experts involved in public adaptation to flood in the Accra Metropolitan Assembly (AMA), August 2013

From Table 5.1, the thirteen (13) experts interviewed collectively ranked inadequate drainage infrastructure, poor refuse management and housing development in flood zones (encroachment of wetlands and waterways) as the three major causes of flooding in the study localities. One of the technocrats aptly captures how inadequate drainage infrastructure leads to flooding in Accra as:

> *"In most of these areas [that flood in a Accra] storm drains are unavailable and when you have a sudden gush of voluminous water and there is no large drains to accommodate the water and channel it in the right directions to move without destroying things, then it tends to find its own level, move into peoples rooms and destroy things in the affected communities*."
> [Senior Official Metropolitan Health Department, Accra Metropolitan Assembly. July 5, 2013]

The link between poor drainage systems and flooding in Accra and the study communities in particular can be rationalised within the context of a huge deficit in Accra's drainage infrastructure. SNC Lavalin International Inc. and Comptran Engineering and Planning Associates (1997) identified twenty-six (26) priority storm drains, totalling almost 70 kilometres requiring interventions in the city based on the 1991 drainage master plan. By 2007, engineering designs and construction of less than half (about 25 kilometres) were on going under the Second Urban Environmental Sanitation Project (Watertech, 2006).

The huge deficit in the city's drainage network is partly because of inadequate funding. Total development expenditure of the Hydrological Services Department in 2011, 2012 and 2013 amounted to US$5,015,380.00, US$34,364,257.00 and US$24,208,766.00 respectively (MWRWH, 2014). The Drains Maintenance Unit, also experiences funding gaps as development expenditure receipts are always lower than budgetary estimates. Budgetary requests for 2010, 2011, 2012 and 2013 were GH¢900,000.00, GH¢1,200,000.00, GH¢1,500,000.00 and GH¢1,500,000.00

respectively. End of year expenditures were GH¢733,697.00 (≈US$499,114.00), GH¢5,459,200.00 (≈US$3,522,064.00)[3], GH¢750,000.00(≈US$510,204.00) and GH¢842,864.00 (≈US$383,120.00)[4] for the respective years (Accra Metropolitan Assembly, 2014). A comparison of the actual annual expenditure outlays of the various organisations directly involved in drainage improvement in Accra, mentioned above, and the construction cost of some major drains in the city provides a clearer picture of the huge budgetary constraints facing these organisations. The construction cost of the Odaw Storm Drain between the N1 highway and the Graphic Road (7.2 kilometres) in Accra was estimated at US$6 million in 1994 (World Bank, 1994).

The experts in Accra ranked poor refuse management as the second major cause of flooding in the study communities. Evidence of heavily silted drains, lagoons and neighbourhoods are rife in the study areas and other flood prone depressed localities in the city (see Plate 5.1). The experts indicated that the problem is due to poor public attitude towards waste management. For example, an official interviewed gave an account of residents' attitude to waste management during the construction of Odaw storm drain in 1997:

> "*When we were constructing the Odaw storm drain, I was surprised when it began to drizzle, and households living along the drain at Alajo started rushing out of their homes to dump refuse in the drains amidst shouting "bola kaa no aba" (the refuse truck is in). Today, dumping of refuse into drains is still a major problem in Accra."* [Head of Drains Maintenance Unit, Accra Metropolitan Assembly, Accra. 20th August 2013].

[3] The huge expenditure receipt reported in 2011 is due to a direct central government transfer to the Unit after the October, 2011 flood in Accra. The money was released to desilt drains and undertake maintenance works on sections of the city's drainage network after that devastating flood.

[4]Ghana Cedis (GH¢) conversions into United Sates dollars (US$) are based on interbank exchange rates as at 31st December, 2010, 2011, 2012 and 2013 respectively (Source: Bank of Ghana (2014). Statistical Bulletin. Accra: Statistical Division of Bank of Ghana).

The episode described above that gives an indication that poor attitudes to waste management is a major factor in Accra's perennial flooding problem. However, the scientific literature highlights the contribution of inadequate waste management services and infrastructure in the city to the problem of waste management (Nartey et al. 2012; Boadi and Kuntinen, 2002; Lamptey and Abban, 1999). However, an officer at the Metropolitan Waste Management Department of the Accra Metropolitan Assembly had a different opinion. He contends:

"We are trying our best and whatever challenges you see now are temporal. It is due to the closing down of some of the major final disposal sites around Accra. Now the only active final disposal site is Kpone which is after Tema and because of the distance, the turn-around time for the trucks has increased that is why you see the waste piling up. However, there are on-going efforts to open up new disposal sites. When this is done the problem will be resolved."
[A Senior Officer, Waste Management department Accra Metropolitan Assembly, Accra, 22nd August 2013]

The scientific studies used the low collection rates of the city's municipal waste as the major explanation for the poor refuse management in the city. However, expert opinions link poor public attitude to environmental sanitation to the filth that clogs drainage systems in Accra and hence causes flooding in the metropolis.

Plate 5.1: Open Dumping in Glefe

Plate 5.2: Building in Waterway-Glefe

Source: Author's Field Work, June 2014

For the technocrats, housing development in flood zones is the third most important reason why Accra floods (see Plate 5.2 above). The technocrats especially those involved in town planning and development control attribute the problem mainly to indiscipline in the land market and developers eager to flout the zoning and building regulations. A building inspector in charge of one of the study communities in Accra provides a vivid insight into how developers in poor flood prone communities evade the planning authority when he said:

"the process of enforcing the law [zoning regulation] in poor flood prone areas is not that easy because some of these places are inaccessible and dangerous. They [developers]are building quickly at night and serving wall notices on themselves. So the notification numbers are fake [not authentic] and the courts throw out our application [for demolishing]. Some also destroy the wall notices by painting over them so that we cannot easily trace it. These conditions are very challenging so you cannot do much without support." [A Young Building Inspector in charge of one of the study localities, Accra 13th September 2013]

The lack of support mentioned by the building inspector is interpreted in this case to encompass both human and material resources like vehicles as well as institutional support. Accra covering an area of approximately 200 square kilometres has only four (4) town planning officers and 31 building inspectors; supported by two vehicles for development control [Interview with a Director, Town and Country Planning Department, Accra. 3rd June 2013]. Lack of resources limits the capacity of metropolitan planning authority to take proactive steps to control encroachment on waterways and haphazard housing development that cause and/or exacerbate flooding especially in the poor enclaves of the city.

Sanctions imposed on defaulters in Ghana's planning legislation are lenient. Section 64(6) of The Local Government Act of 1993 (Act, 462) prescribes a minimum fine of GH¢20.00 for developing without building permit. Although Yeboah and Shaw

(2011) argue that the courts have the power to review the fine upwards, in most cases, the penalty is a fraction of the total cost of obtaining a building permit. This situation, according to a senior town planner in Accra, "supports indiscipline among developers." [Interview with a Director, Town and Country Planning Department, Accra. 3rd June 2013].

More importantly, the inadequate of support for development control mentioned by the young building inspector is also because of a value system that protects those who flout building regulations especially in poor urban communities. Developers in these communities are considered poor and ignorant; therefore, they have the sympathy of the general public. In addition, housing in the Ghanaian context has spiritual and cultural significance. The Akan adage, '*Yɛbisa wo fie na Yɛnbisa wo sika*[5]' reflects the high social value placed on housing within the Ghanaian context. Therefore, demolishing of houses is frowned upon within the traditional cultural setting. The consequences of demolishing in the social context are sum up by one building inspector as follows:

> *"Demolishing is really a last option. If you go about demolishing people houses, you become a bad person and if are not lucky, you will be cursed and your life will not end well. You can even die suddenly [through spiritual means] so you have to be careful."* [A Building Inspector in charge of one of the study localities, Accra. 13th September 2013]

Implicit in the statement above is some form of reluctance on the part of actors involved in zoning regulation to enforce the law for fear of socio-cultural reprisals.

[5] An Akan [Dominant ethnic group in Ghana] adage the literally means that people will ask for your house and not your money. This implies in the traditional Akan setting a house is more important that huge bank balances. Such notions about the importance of buildings are dominant among other ethnic groups in Southern Ghana.

Other causes of flooding mentioned by the experts are drainage problems elsewhere, in this case storm water from the Akuapem Mountains. An interview with the Director Metropolitan National Disaster Management Organisation reveals, “sometimes Accra floods even when it has not rained heavily here [Accra]. The water comes from ‘Mountains’ [Akuapem ridge].” [Interview with Metropolitan Director of National Disaster Management Organisation, Accra. 12th August 2013]. Other causes of flooding mentioned are natural resource exploitation like sand mining (winning) along the coast, heavy rainfall and poor planning (poor building orientation) in order of merit.

Community leaders in Glefe and Mpoase associate flooding in their communities with their physical location in a flood prone zone. They also mentioned natural resource exploitation for economic gains and the staggered effect of drainage problems of Dansoman and Agege also as major causes of flooding in their communities. Glefe and Mpoase are located within the Densu Ramsar site and are bounded by two coastal lagoons whose estuary is lower than mean sea level. Also found in Mpoase is a tributary of the Lafa river. During high tide the sea intrudes into the lagoon whereas the lagoon overflows its banks during moderate and heavy rainfall leading to fluvial flooding. The low-lying nature of Glefe and Mpoase also lends itself to ponding, as the topography does not support natural drainage of storm water. The hydrogeological characteristics of the two study communities exhibit a high water table making the two communities susceptible to ground flooding.

The focus group made up of community leaders from Glefe and Mpoase explains that by virtue of being along the coast, Glefe suffers from coastal flooding. The opinion leaders revealed that over the past 10-15 years they have observed the gradual recession of the coastline. To support this claim, a female opinion leader who claimed she was born in the Old Glefe Township, now submerged under the sea recalls that: “There was the sea, a beach planted with coconut trees and then the community which was about 50 metres from the end of the beach.” [Aunty Mercy, 60-year Old Resident Glefe beach, Glefe-Accra, 1st June, 2013]. A number of studies (Addo and Adeyemi, 2013; Amoani et al. 2012; Oteng-Ababio et al. 2011) have also provided empirical evidence in support of this anecdotal evidence. Amoani et al. (2012) for example, has estimated that coastal recession along the beaches of Glefe, Panbros and its environs hovers around 1.2 metres per annum.

A more intriguing revelation by the focus group is the mysterious storm surge that has been occurring in the community intermittently. The focus group could not agree on the exact timing of the event but the consensus was that the event occurs between June and October. The deposition of some brownish weeds (algae) on the beach normally precedes the tidal wave attack. The community leaders claim that the most devastating event occurred in July 2010. This incident according to the group led to the loss of one life and displacement of about 100 families along the Glefe coast. An aged female opinion leader who experienced the storm surge of July 2010 describes the horrendous event as follows:

“It was around 3-4 a.m. when I heard the sea making rumbling noises. After a few minutes, the first waves shook my building, and then the second one swept through the house. I started shouting for help, the neighbours came and helped move my family and me out of the house. That night we took shelter in a friend’s house further in land. In the morning when I came round with the Assemblyman, NADMO officers and other opinion leaders, I saw that my building was all gone and I heard that people in the next two houses were badly hurt and some had been sent to Korle bu [hospital]. I lost all my belongings, my corn dough business suffered because the waves washed everything away leaving me in debt but I thank

God that me and my family are alive. It was terrifying." [Aunty Akosa, 65-year Old Resident Glefe beach, Glefe-Accra, 1st June 2013]

There are two accounts in the literature that explain the storm surge and deposition of algae along the beach. Armah et al. (2005) attribute these storm surges/tidal wave attacks to upwelling and turbulence in the Atlantic Ocean. They further explain that these activities are also responsible for detaching the algae from their substrate and drifting them ashore. Hence the deposition of the weeds on shore prior to the storm surge. ScienceDaily (2008) however indicates that storm surges are as a result of a sudden rise in the intensity of winds blowing over the sea due to climate change.

Glefe's low lying and open coastline aggravates the adverse effects of tidal waves in community. According to Addo and Adeyemi (2013), sections of the Glefe beach have elevations as low as below 0.2 metres. This exposes the community to frontal attack from swell waves and spring high tides.

The community leaders also observed that the incidence of flooding in Glefe and Mpoase is an externality of massive natural resource extraction in the area. This was ranked second in Table 5.1 with a score of 17. Anecdotal evidence provided by a sub chief of Mpoase has it that gravel material used during construction of Dansoman Estate in Accra in the 1970s was sourced from the environs of Glefe and Mpoase. This situation further reduced the elevation of the area relative to the sea and the Gbebu and the Gyatakpo lagoons.

There was consensus among the community leaders in Mpoase and Glefe that the diversion of the estuary of the Gyatakpo Lagoon and creation of an embankment by

Panbros Salt Manufacturing Limited[6], a salt mining company located within the Densu Ramsar site, West of Glefe and Mpoase is the second most important cause of flooding in the area. (see Fig 5.1 for the Panbros embankment within the context of Glefe, Mpoase and its environs). A member of the Glefe Development Association who was part of the opinion leaders' focus group explains:

> *"Formerly, the lagoon did not directly enter sea at the point you see now [near Glefe], it flowed westwards through the area which Panbros has now converted into their salt ponds, towards the Densu River and finally into the sea near Bojo beach. Around 1992 Panbros [Salt Manufacturing Limited] blocked the watercourse through the wetland and diverted the [Lagoon] water southwards near Glefe. Initially, they provided an outlet that we could open during the floods so that the storm [lagoon] water can flow over the wetlands. Recently, they have blocked that culvert permanently so the only way for the water to flow out of the community is through the diversion directly into the sea but the point is that the point at which the lagoon joins the sea [estuary] is lower than the sea. So anytime it rains slightly on land we have serious problems [flooding] and then when it rains on the sea it flows back into the lagoon and floods the houses along the lagoon. Our area is perpetually flooded at least for four months in a year* [Akwesi Frimpong, A 42 year Old Resident of Glefe West, Accra. 2nd June, 2013].

An opinion leader from Mpoase also identifies with this position and asserts that:

> "*the activities of Panbros cover the wetlands west of Mpoase to the sea. The salt ponds are bound by high borders [embankments] which does not allow run off from our area [Mpoase Opetekwai Area] to flow into the Densu River and then into the sea. This side of the Lafa river has also been blocked so it does not flow into the sea"* [Nii Pappoe, 40 years Traditional Ruler in Mpoase, Accra 2nd June 2013].

[6] Panbros Salt Manufacturing Company Limited is a leading salt manufacturing firm in West Africa with the capacity to produce 45,000 tonnes per annum. The company owns and operate an 11,000-hectare concession in the Densu Ramsar site in the western part of Accra. The concession shares a common boundary with Glefe and Mpoase in the east at the Gyatapko lagoon. In 1992, the company created an embankment around its salt ponds and undertook diversionary works at the estuary of the Gyatapko lagoon. As part of the civil works a cross culvert was created within the embankment near Glefe to allow excess seawater backfill into the Gyatapko lagoon during high tide in order to balance the flow in the salt ponds. The culvert was blocked during low tide to prevent reverse flow of contaminated lagoon water into the salt ponds. These measures according to an official source of the company were "to protect their operations from pollution from the residents of Glefe, Mpoase and other communities in the catchment, which was contaminating their flows." The company is yet to regularise these civil works with the Environmental Protection Agency in line with L.I.1625 although the company official interviewed indicated that works were designed and supervised by staff of the Hydrological Services Department privately. No community agitation was reported at the time the civil works were undertaken.

Figure 5.1: Arial View of Glefe and Mpoase Showing Panbros Salt Manufacturing Limited's Embankment and Diversionary Works

Panbros Salt Manufacturing Limited disagrees with the view that its expansionary activities are a major cause of flooding in Glefe and Mpoase. A senior manager of the company, who articulated the position of the company on this matter, provides the rationale for creating the embankment, diversion and culvert. He states:

"That whole area [the Gyatakpo lagoon and the lands around it] was part of our concession. Formerly, when we pump the seawater it was passing through the lagoon and then into our system. These people [inhabitants of Glefe and Mpoase] were on the other side of the lagoon. Now we realised they [inhabitants of Glefe and Mpoase] were dumping all sorts of things into lagoon and contaminating our flows. So all that we [Panbros Salt Manufacturing Limited] did was to cut off a portion of the area and create an embankment so that the seawater, which we use for our operations, is not contaminated by water from the polluted lagoon and a culvert, which will provide an outlet for excess water from our operations when it rains. We had to spend money to construct gabions to protect the coast from erosion and a channel to allow the lagoon to flow into the sea. Finally, because we knew that the action of the waves will deposit sand to block the estuary we have permanent workers there to open the estuary when it rains. Sometimes we hire a pay loader and other equipment to cut the sand bar at the estuary at a cost of about GH¢3,000.00. As a community, I expected them to help [bear part of the cost] because they are part of the problem but nobody offers any help" [Senior Manager, Engineering, Panbros Salt Manufacturing Limited, Accra. 14th May 2014].

The community leaders do not contest the Panbros claim of land ownership but refute the allegation of being apathetic to the situation. They argue that, at the onset of the rainy season they organise communal labour to cut the sand bar at the estuary. They also accuse the Company of reneging on their promise to dredge the estuary ahead of the rainy season. However, the senior manager interviewed, further revealed that after the civil works more buildable land became available in the community, which fuelled the south-western expansion of the two communities towards the wetlands, a situation that he deems as the "unfortunate cause" of flooding in the two communities. He continues:

"At the time we did these interventions [diversion and embankments] there wasn't much habitation along their side [Glefe and Mpoase] of the land where the water used to pass. It was all bushes. Unfortunately, for them because at one point we cut the lagoon off, the former waterway become dry and they built on it. Therefore, as I am speaking to you now they are sitting on the waterway. Somebody also decided to direct all the drains from Dansoman Estate into the lagoon without any investigation as to what the impact will be on the people. In addition, the tidal waves that struck some time ago destroyed the gabions and other interventions around the estuary but we are there and anytime it rains, we make sure that we

clear sand and silt and the water goes into the sea. But my brother the area is terrible" [Senior Manager, Engineering, Panbros Salt Manufacturing Limited, Accra. 14th May, 2014]

The position of Panbros Salt Manufacturing Limited favours the locational (building in flood zone) argument made earlier by the opinion leaders as the cause of flooding in Glefe and Mpoase and not the activities of the company within the Densu wetlands. It also confirms the occurrence of the storm surge along the Glefe beach and destructive tendencies it had on their coastal protection works along the beach. Finally, it hints of the adverse externalities of drainage improvement works in Dansoman and its environs on flooding in Glefe and Mpoase.

Apart from the locational argument, Panbros Salt Manufacturing Limited perceive that flooding in the two communities is rather caused by a combination of encroachment on the Densu Wetlands and the out falling of major drains from Dansoman and other areas into the Gbugbe and Gyatakpo lagoons. He states,

"You yourself you've been there [Glefe and the other communities] and you've seen how people are filling the wetland, even if I take you to Dansoman Tunga Down, near our embankment people are filling with Bola [refuse] and building. I have gone to workshops and reported to both AMA [Accra Metropolitan Assembly] and Ga South Municipal Assembly. They are not doing anything about it. You have a car let's go and take pictures, people are settling in this Bola area [bad area]. There are all sorts of people living in these communities, Ewes, Nigerians, Togolese etc. You ask them, why they are settling in the swamp? They tell you, 'na this be water?' [Is this is a swampy area?]. You know Lagos and most of these areas are swampy so they say they can reclaim the vegetation and build in there. How can you build in this area? This area is a Ramsar site and people are encroaching but the authorities do not want to talk [act]. Birds used to come all over the place so formerly we had signboards with instructions like "do not shoot" to protect the birds. But if people are migrating and developing the area and polluting the water, which bird will you find there, which bird will come and drink this dirty water. We also suffer from encroachment because when it rains about 50% of our land [ponds] i inundated and the whole area becomes one big lagoon. [Senior Manager, Engineering, Panbros Salt Manufacturing Limited, Accra. 14th May 2014].

The official interviewed puts the blame on the Accra Metropolitan Assembly and the community leadership for not enforcing both the building regulations and the Ramsar Convention.

Sand mining along the beach to feed the booming local construction industry has become a source of livelihood for the youth of Glefe and Mpoase. This notwithstanding, it creates more avenues for seawater intrusion during high tide and reduces the availability of beach sand that break the tidal waves. Another activity in the extractive sector that was said to have increased exposure to coastal flooding in Glefe and Mpoase is mining seashells from the beach and in the shallow waters around Glefe. The seashells when mixed with cement and sand forms an ornamental construction material used in the fabrication of floors and walls referred to as 'Terrazzo'[7].

However, removal of the seashells according to the opinion leaders exposes the beach to tidal wave attack. This is because the cowries (seashells) act as a form of coral reef, which reduces the energy of the approaching waves, hence reducing the impact of storm surge and tidal waves along Glefe's coast. On the perceived association between sand and terrazzo mining and coastal flooding, a female opinion leader who lives along the Glefe beach had this to say:

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[7] An ornamental building material produced with seashells and cement. It was the preserve of high-end architecture in urban Ghana between 1960 and 1980s. Its appeal among high-income earners has declined since the 1990s but there is growing demand for the product among lower middle-income developers. The local people refer to the seashells as Terrazzo because it is a major input for the building material.

"Being aware of the high tide we built our homes far from the high tide line. But because the youth are winning sand and terrazzo along the beach, the waves are now able to reach us. The Terrazzo acted like a sieve, it slowed down the waves and protected us from the force of the sea. Sand and Terrazzo winning has made the shore weak making it easy for the waves to wash it away. These people must be stopped." [Aunty Martha, 53 years, Resident of Glefe Beach, 1st June 2013]

Further discussions indicated that sand winning the Accra Metropolitan Assembly has banned sand mining in the area but enforcement is weak because it is purported that the youth who are engaged in this practise work for the elite in the two communities.

In Table 5.1, the community leaders in Glefe and Mpoase at the focus group discussion ranked cumulative effects 'drainage problems from elsewhere' as the third most important cause of flooding in the two communities with a score of 13. The improvement of the drainage network in Dansoman and Opetekwei under the Mamponse Infrastructure Upgrading Project from the perspective of the opinion leaders has compounded the flooding problems of the two communities. They explain that areas liable to floods have increased since the completion of these drainage interventions.

Under these initiatives, all the drains in Dansoman and Agege in Accra were directed into the two lagoons. Gbugbe and Gyatakpo lagoons therefore became the outfall and principal outlet for storm water and runoff into the sea. Interestingly, interventions to improve the storage capacity of the Gbugbe and Gyatakpo lagoons and their discharge velocities into the sea did not complement the drainage improvement works. The lagoons therefore overflow their banks after the slightest rain, flooding adjoining houses in the two communities.

Table 5.1 also presents the views of community leaders in Agbogbloshie on the causes of flooding in their community. It reveals that the community leaders perceive that flooding in their respective communities is largely as a result of poor planning and the burden of drainage problems outside their community. In addition, the underdeveloped drainage systems in the community make storm water and run off conveyance into the Odaw River for onward discharge into the sea problematic. On the issue of poor settlement planning and development control, which the community leaders assigned the highest priority, one male focus group participant contrasts the layout of Agbogbloshie in his formative years to the current situation. He recalls with nostalgia:

> *"When I came to Agbogbloshie I was about six years old and this was in 1962. The town was well laid out with well-demarcated streets, parks and avenue trees. The population density was low and so we knew each other to the extent that when you mention a house number even a child can lead you there. Now the town is congested and people have built in unauthorised places. Currently, when you say you live in Agbogbloshie I do not know you. The town looks like a shantytown and we are classified as squatters because wooden shacks have taken over the community. However, I do not blame the developers; it is the fault of the landowners, who sell [lease out] the land to prospective developers without a plan. Because of these things when it rains we suffer from flooding."* [Mr. Ernest Amponsah, 59 years, Opinion leader Agbogbloshie, Agbogbloshie, 14th July 2013*]*

The statement above refers to congestion and development of shacks "without any plan" as the underlying causal factors of flooding in Agbogbloshie. Uncontrolled development of housing in Agbogbloshie has been linked to the construction of a regional market close to the residential quarters and the proximity of the community to the Kokomba (Yam) market along the Abossey Okai road. These developments increased the demand for land to accommodate the traders and ancillary workers at the market. Trading activities have also spilled over into the residential areas.

The opinion leaders of Agbogbloshie try to resist any association with Old Fadama (Sodom and Gomorrah) and the Kokomba Yam Market off the Abossey Okai Road. However, there is no doubt that these activities have attracted people into the corridor, creating congestion and stimulating demand for land for residential and commercial uses within the Abbosey Okai road corridor. Petty landlords have taken advantage of the situation to lease out land without any recourse to the existing layout of the town. The resulting high residential densities and site coverage lead to inadequate space in between houses for storm water and run off to flow out of the community.

Similar to the community leaders in Glefe/Mpoase, those in Agbogbloshie are of the opinion that their community suffer from the staggered effect of drainage problems carried from communities upstream the Odaw River. This factor was ranked second by the opinion leaders in Agbogbloshie with a score of 16. One female focus group participant forcefully conveys this sentiment when she explains how this phenomenon unfolds,

"There is a big drain coming from Accra Central through the Makola II Market that traverses the community and joins the Odaw river. The drain is heavily silted with refuse from the Accra Central, Makola II Market and even the Agbogbloshie Market. When it rains the drain carries refuse from upstream and deposits it here in our community. The refuse clog the drain and the [storm] water begins to flow backwards [backfill] leading to flooding in our community. It can flood up to knee level. Even during last year's flood the water was above my knee."[Hajia Kande, Secretary of the Agbogbloshie Landlords Association, Agbogbloshie –Accra, 14th July, 2013]

The cumulative effect of poor upstream management practises become an externality for communities in the lower catchment of major rivers in Accra like Agbogbloshie located within the lower Odaw catchment.

From Table 5.1, the community leaders in Agbogbloshie scored under developed drainage infrastructure in the community 16, making it the third most critical cause of flooding in the community from their perspective. The main drain that traverses the community from Accra Central into the Odaw River was constructed in the 1998. A few tertiary drains have been constructed to link this secondary drain. The project has been abandoned because of inadequate funding. Other causes of flooding mentioned by the opinion leaders of Agbogbloshie ranked in descending order are: poor refuse management in the community, building in flood zone, heavy rainfall, and Act of God.

Households in the three communities perceive that the most important causes of flooding in their communities are poor drainage network, poor planning/development control and heavy rainfall. Households in Agbogbloshie and Mpoase ranked poor drainage as the highest among the numerous causes of flooding in their community. It was also the third most important cause of flooding expressed by the households surveyed in Glefe. This is not surprising as only 12.9%, 24.9%, and 45% of the households surveyed in Glefe, Mpoase and Agbogbloshie respectively lived in houses with a concrete public drain in front. Of these, 46.2%, 35.5% and 70.4% observed that the drains were choked while 15.5%, 19.4% and 14.8% indicated that the drains in front of their homes were cracked. This is against the background that Part XIII Section 116(1)(2) of Ghana's National Building Regulations (L.I.1630, 1996) requires every property to have a drainage system that links to an outfall or drain provided by the District Assembly, in this case the Accra Metropolitan Assembly.

Poor planning (settlement layout) was also identified by the households surveyed in Glefe as the number one cause of flooding in Glefe with a total score of 120 and the third in Agbogbloshie with a score of 62. The rationale for this outcome is not far-fetched. Housing development in the two communities has been haphazard and dense with virtually no open spaces and nature reserves. This is against the background that Glefe developed spontaneously, while the initial development of Agbogbloshie was in accordance with a planning scheme (Grant, 2006). Many buildings in Agbogbloshie and the other two study communities are not directly accessible by vehicles. This is against the background that Part 1 Section (7) of the national building regulation (L.I.1630, 1992) stipulates, “no person shall construct any building on plot unless the building abuts an approved street or the site of an approved street for a distance of at least 3 metres.”

In addition, most building plots are as small as 100 square metres far lower than the minimum standard of 450 square metres stipulated in Part 1 Section 14(1) of The National Building Regulations (L.I.1630, 1992). Most buildings in the three study localities are in breach of the maximum site coverage (60%) stipulated in the Part Section 14(2) of the building regulations (L.I. 1630, 1992). It estimated that the net residential density of Glefe, Mpoase and Agbogbloshie is 21, 13 and 23 houses per acre respectively. This is far in excess of planning standard of seven houses per acre for low-income high-density areas in Ghana. Under these conditions, it is not possible for runoff to drain out of individual properties easily leading to ponding.

Heavy rainfall with a score of 112, 184 and 97 in Glefe, Mpoase and Agbogbloshie respectively came second in the household ranking of the three study communities in

Table 5.1. Although the empirical evidence associating flooding in Accra to increasing rainfall intensity and volume is not very convincing (see Figure 4.10), the number of major flood events in Accra increased from two (2) in the 1950s to eleven (11) between 2000 and 2009. Most of the major floods in Accra are occasioned by rainfall with intensities of more than 50mm/hr. However, households living in these communities experience flooding even under moderate rainfall. This explains why heavy rainfall ranked high as a cause of flooding among the households surveyed. Other causes of flooding enumerated during the household survey were building in flood zones and drainage problems elsewhere.

5.5 Agreement/Disagreement on the Perceived Causes of Flooding Among Key Actors

The results of investigations into the level of agreement/disagreement on the views shared in Table 5.1 with respect to the causes of flooding by households, community leaders and experts in the public sector in Accra are presented in Table 5.2. These were analysed using Kendall's Co-efficient of Concordance.

Table 5.2: Level of Actor Agreement on the Causes of Flooding

Actors/Stakeholders	Co-efficient (W)	P-Value
Households versus Households		
Glefe-Mpoase	**0.722*** **	0.007
Glefe- Agbogbloshie	**0.873*** **	0.001
Mpoase-Agbogbloshie	**0.704*** **	0.009
Household versus Community Leaders		
Glefe	0.278	0.297
Mpoase	0.222	0.409
Agbogbloshie	0.432	0.116
Experts at AMA Versus Households		
Glefe	0.085	0.753
Mpoase	0.222	0.404
Agbogbloshie	0.389	0.144
Experts at AMA Versus Community Leaders		
Glefe/Mpoase	**0.444***	0.095
Agbogbloshie	0.278	0.297

*****= p<0.01=1% level of significance, ** P<0.05 = 5% (level of significance), * =p<0.1=10% level of significance**

Table 5.2 reveals that households in the three study communities seem to share similar opinions on the relative importance of factors that cause flooding in their various communities. The Kendall Co-efficient of Concordance (W) points to a strong agreement in the perceptions expressed by the households surveyed across the three study localities (Glefe-Agbogbloshie W=0.873, p=0.001; Agbogbloshie-Mpoase W= 0.704, p= 0.009; Glefe-Mpoase W= 0.722, p=0.007). This implies that there was an 87.3% level of agreement on the causes of flooding between the households in Glefe and Agbogbloshie. Between the households surveyed in Agbogbloshie and Mpoase and those of Glefe and Mpoase, the degree of agreement was 70.4% and 72.2% respectively. The levels of agreement were statistically significant at 1%. Underlying this strong agreement in the perceived causes of flooding among the households in the three communities are similar spatial and socio-economic characteristics.

In Table 5.2, opinions on the causes of flooding between household and community leaders' in various communities did not coincide. For Agbogbloshie, Glefe and Mpoase, the level of agreement in Table 5.2 were 43.2% (W=0.432; p=0.116), 27.8% (W=0.278; p=0.297) and 22.2% (W=0.222; p=0.409). These were not statistically significant. In an ideal situation, such low level of agreement between community leaders and households should not have arisen, as views of the opinion leaders should be representative of that of the households. Nonetheless, there are some explanations under this circumstance. The community leaders were more interested in the remote causes of the problem whereas the households are generally interested in the immediate causes of flooding, getting runoff and storm water out of their compounds and immediate surroundings.

A more insightful revelation in Table 5.2 is the observed disagreement between the experts interviewed on one side and the community leaders and households on the other. The estimated level of agreement between experts interviewed and households in Glefe, Mpoase and Agbogbloshie was as low as 8.5% (W=0.085; p=0.753), 22.2% (W=0.222; p=0.404) and 38.9% (W=0.389; p=0.144) respectively. Similarly, between the experts consulted and opinion leaders in the respective communities, opinions on the causes of flooding also differed. The degree of agreement was moderate, 44.4% (W=0.444; p=0.095) for Mpoase/Glefe and low, 27.8% in the case of Agbogbloshie (W=0.278 p=0.297). The level of agreement between the expert opinion on the causes of flooding and the community leaders at Glefe/Mpoase was statistically significant at 10%. In the case of Agbogbloshie, it was not statistically significant.

These low levels of agreement between the households surveyed, community leaders and technocrats observed in Table 5.2 are supported by some revelations from Table 5.1. For example, in Table 5.1, the community leaders in Glefe/Mpoase rank the natural resources extraction as the second most important cause of flooding in the two communities but this did not feature prominently in scheme of things of the experts. In addition, the experts interviewed put a high premium on poor refuse management in the city, including the study communities as a cause of flooding but the households and community leaders in the various study communities did not rank it among the first three causes of flooding in their respective communities.

The difference between the opinions of the technocrats and ‘local’ knowledge on the causes of flooding can be attributed to the fact that opinion leaders and households are more in tune with local dynamics of flooding in their respective communities than the experts operating at the metropolitan level. These differences also confirm Douglas et al. (2008) observation that flooding in most African cities is a localised problem.

Some level of externalisation of responsibilities and blame (Lorenzo et al. 2007) can also be inferred from the narratives ensuing from Table 5.1. Both the household surveyed and community leaders explained that flooding is largely as a result of exogenous factors like heavy rainfall, activities of Panbros Salt Manufacturing Industries Limited and drainage challenges elsewhere, obfuscating their own contribution to the problem in the form of poor attitude towards refuse management and haphazard housing development.

The officers in the public organisations surveyed also emphasised poor drainage systems, indiscipline in the land market (poor planning) and poor refuse management as the major causes of flooding in Accra. Their explanation of how these factors lead to flooding in the city absorbs them of any blame and lays the blame on indiscipline on the part of community leaders and households who flout building and zoning regulations and dump refuse into open drains, lagoons and in the neighbourhoods. Externalisation of blame can act as a barrier to public adaptation to floods. This because it constraints co-operative governance required for adaptation (Anderson et al. 2008).

5.6 Conclusion

Views and knowledge about a phenomenon are diverse even at the local level (Hilhorst, 2013; Arce and Long, 1992). Perceptions and actor interests influence these diversities in views and opinions. The level of agreement on the relative importance of each of the perceived causes of flooding differed from each of three groups of actors surveyed. There were also differences between prepositions on the causes of flooding in Accra from the scientific literature and the views of the actors elicited during the study.

Within the study communities, the level of agreement on the causes of flooding between community leaders and households also differed considerably. This reveals that knowledge domains on how disaster risks unfold are devise and sometimes conflicting even at the community level (Hilhorst, 2013). As noted by Hilhorst (2013:11), “local knowledge cannot be represented as an accumulating and homogeneous community stock.”

A strong level of agreement on the causes of flooding was achieved among the households surveyed as well as community leaders in the three study communities supporting the argument by Bruun and Kalland (1995) that local discourses on issues tends to coincide among people of similar groups or social standing. It also confirms the position held by Sabatier (1987) and Sabatier and Jenkins-Smith (1999) that actors within a particular policy field can be grouped into competing coalitions (groups) based on similar interest, core and non-core beliefs.

Finally, Patt and Schroder (2008) also reported wide variations in perceptions about how floods risk unfolds between farmers and policy makers in Mozambique. In their study, they trace these differences in perception to behavioural factors. This study however, suggests that different actor interest, knowledge on flooding and externalisation of blame are the main drivers of the differences in perceptions about the causes of flooding among key actors in Accra.

CHAPTER SIX

PUBLIC ADAPTATION TO FLOODS IN ACCRA: CHALLENGES IN ACTOR NETWORKS AND ACTOR

6.1 Introduction

Adaptation processes involve the interdependence and relationship among agents within institutions (Adger, 2003). This chapter is a presentation of the actors involved in public adaptation. The chapter explores the challenges that impede effective collaboration among the various actors in flood adaptation (drainage improvement and flood risk zoning) using institutional network maps. Finally, public flood adaptation actions undertaken by the metropolitan and community level actors are also analysed. The objective is to understand the rationale behind the actions and the challenges in the actor networks.

6.2 Institutions Involved in Flood Adaptation in Accra

The Accra Metropolitan Assembly is a key institution involved in flood adaptation in the city of Accra. The legislative instrument (L.I.1500, 1989) establishing the Assembly charges it to ensure public safety in Accra, including public protection from the adverse impacts of floods. Section 46 of the Local Government Act, 1993 (Act 462) also confers powers to plan and control housing development on Assemblies, which include preventing housing development in hazardous places like flood plains. Within the Assembly, a number of decentralised departments are responsible for implementing flood adaptation measures and various legislations back the functions of these organisations with respect to flood adaptation (see Figure 6.1 for the legislations). The decentralised departments involved in flood adaptation in Accra are

Town and Country Planning Department, Metropolitan Health Management Team (Metropolitan Health Department), Metropolitan Public Health Department, Metropolitan Works Department, Waste Management Department, National Disaster Management Organisation and Metropolitan Roads Department. There is also the Drains Maintenance Unit of Accra Metropolitan Assembly established in 2005 to co-ordinate routine maintenance and desilting of Accra's drainage network as well as the supervision of construction of drainage works in the city.

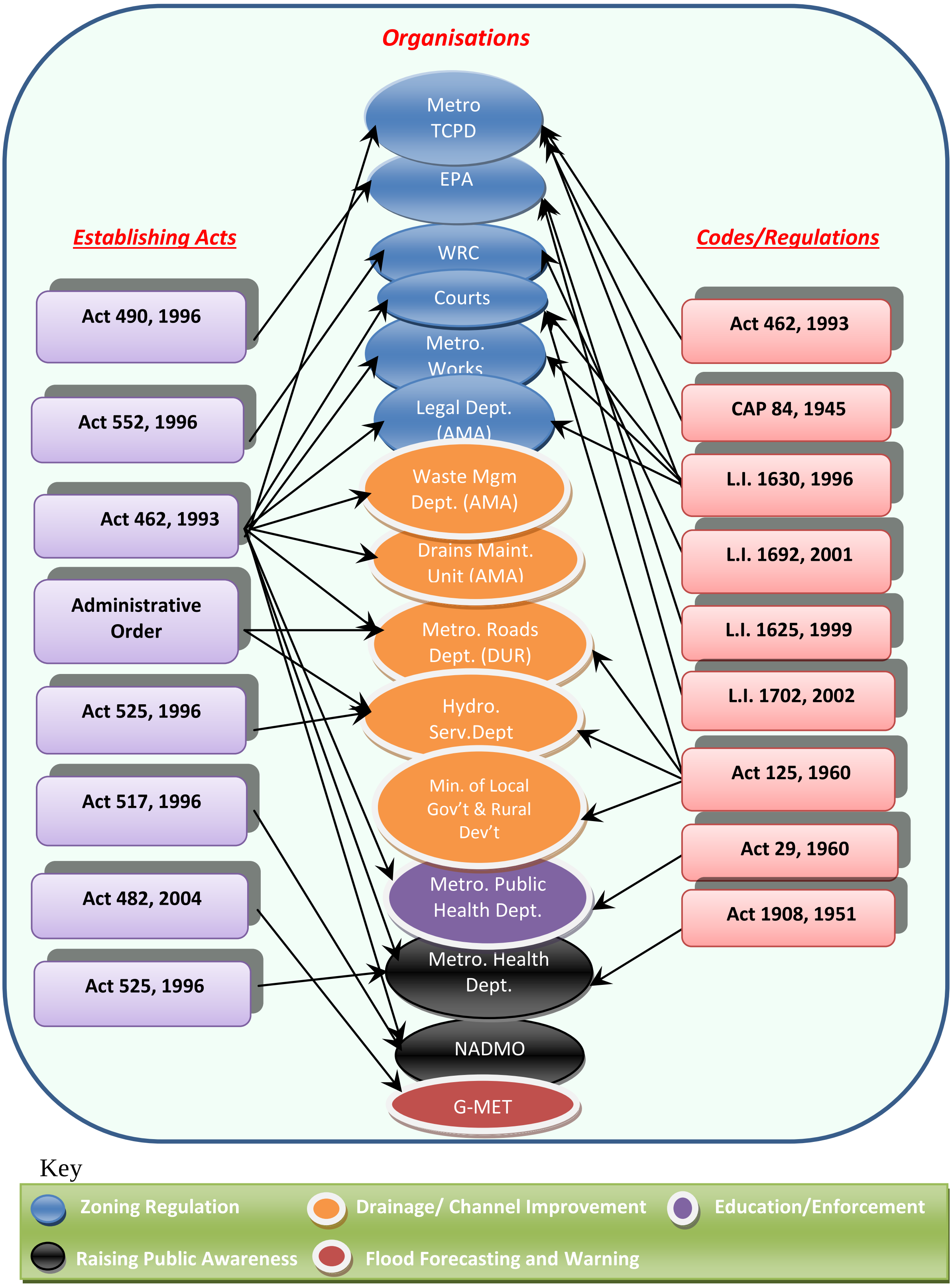
The National Disaster Management Organisation, Metropolitan Health Department, Metropolitan Roads Department, Town and Country Planning Department have national and regional offices. These agencies are also under the supervision of sector ministries. The Metropolitan Roads Department is under the Ministry of Roads and Highways, whereas the Metropolitan Health Directorate and the National Disaster Management Organisation are under the Ministry of Health and Interior respectively. The Ministry of Environment, Science and Technology has jurisdiction over the Town and Country Planning Department (Head office). The Ministry of Local Government and Rural Development oversees all district, municipal and metropolitan assemblies in Ghana including the Accra Metropolitan Assembly and its decentralised departments.

In addition, there are organisations outside the local government authority with functions that impinge on public adaptation to flooding in the Accra metropolis. The Ghana Meteorological Agency (Ministry of Communication), Hydrological Services Department (Ministry of Water Resources, Works, and Housing), Water Resources

Commission, Environmental Protection Agency and the judiciary (magistrate and high courts) make up the list.

These organisations by the law are to undertake measures that minimise exposure and vulnerability to urban floods. The measures implemented so far in the city broadly fall under river channel and drainage improvement, flood forecasting and warning, public awareness creation about adverse effects of flooding and land use zoning/regulation. Parker (2007) describes these actions as flood adaptation measures. Figure 6.1 presents the key public organisations involved adaptation to floods in Accra, the various aspects of flood adaptation in which they are involved in and the enactments that support their flood adaptation functions in Accra.

Figure 6.1: Codes, Existing Acts and Related Organisations in Flood Adaptation in the Accra Metropolitan Area



Source: Author's Construct June 2014

Apart from the formal organisations involved in flood adaptation in the city enumerated in Figure 6.1, there are also non-state actors whose activities influence flood adaptation in Accra. These are chiefs, clan and family heads who are the traditional owners of land, lagoons, rivers and other water resources. The 1992 Constitution of the Republic of Ghana acknowledges their land ownership rights (Government of Ghana, 1992).

There are also community-based organisations that press for flood abatement projects for their respective communities and undertake community mobilisation for adaptation. The Constitution allows for their existence under the freedom of association clause. In spite of the fact that statutory law recognises the existence of these informal institutions, they have not been assigned any role in flood adaptation in Accra. The informal actors obtain their normative power from customary practises and norms.

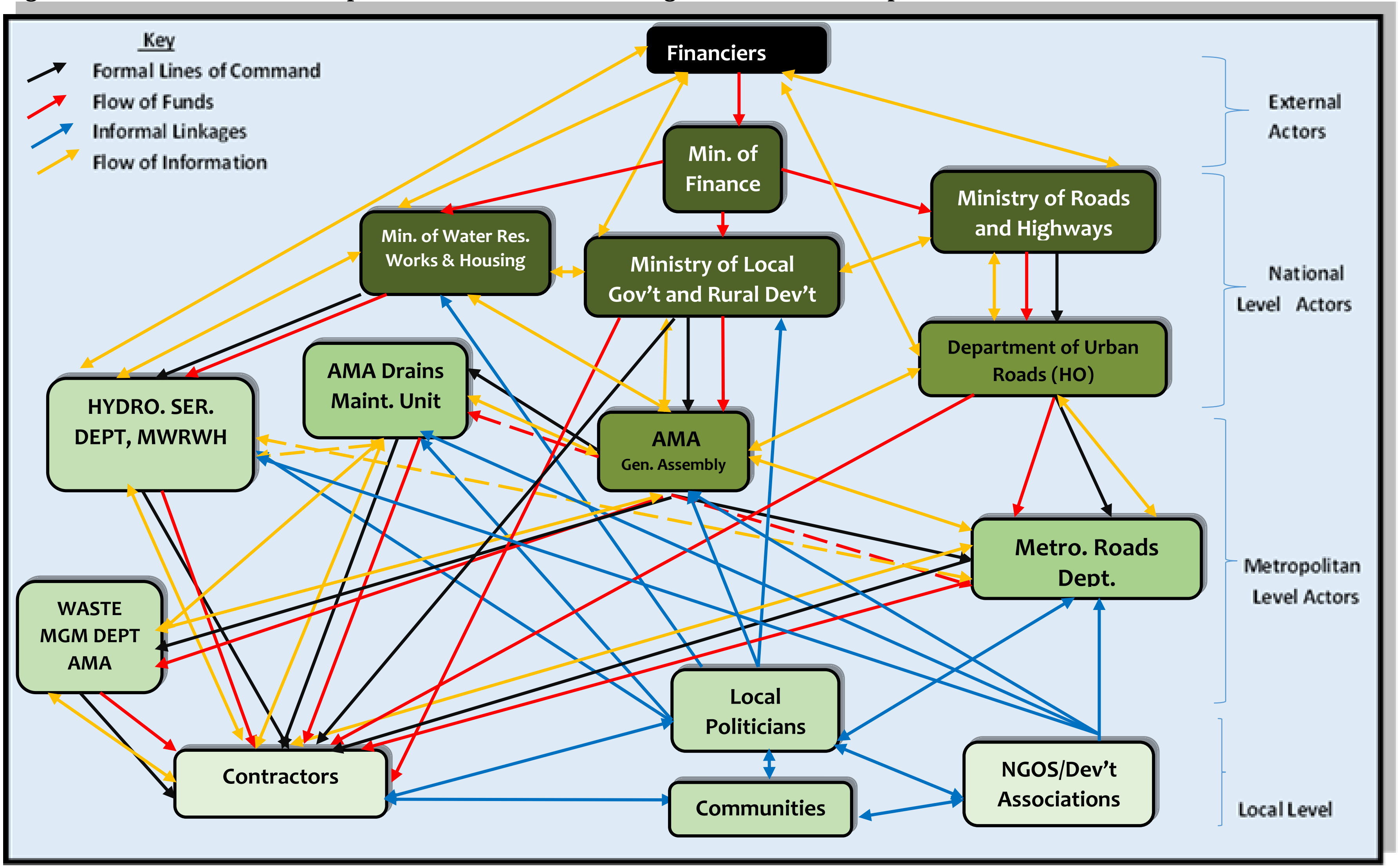
6.3 Challenges in the Network of Actors in Public Flood Adaptation in Accra

Public adaptation to floods involves co-ordination and role-playing among formal and informal actors (Koch et al. 2007; Naess et al. 2005). This section looks at actors involved in two flood adaptation measures in Accra, drainage and river channel modification/improvement, which is a structural measure and land use planning and zoning regulation for flood risk reduction, considered as a non-structural measure. The objective is to undertake an analysis of the network of actors to highlight the challenges/weaknesses in the ties that adversely affect effective collaboration among them using network maps. Actors involved in flood adaptation at a mini-workshop organised as part of this study drew these institutional net-maps.

6.3.1 The Network of Actors: River Channel and Drainage Improvement

Figure 6.2 presents the network of actors involved in drainage and river channel improvement. The network map portrays actors linked by formal command as well as informal ties. The network map also shows the flow of technical information and funds for project implementation. It illustrates a hierarchy of actors, from local to international, who influence the drainage network and the development of drainage infrastructure in the city.

Figure 6.2: Institutional Net-Map of Actor Involved in Drainage/River Channel Improvement in Accra



*Darker background colours represent more powerful/influential actors **Dash lines represent weak relationships

In Figure 6.2, the external actors in river channel modification and drainage improvement are the financiers namely World Bank, Kuwaiti Fund and OPEC Fund who provide funding and at times technical advice to the various ministries and their sector agencies on drainage projects under various partnership agreements.

There are also national level actors made up of the ministries of Finance, Water Resources, Works and Housing, Local Government and Rural Development as well as Roads and Transport. The ministries have primary responsibilities in the areas of policy, planning and monitoring sector agencies under their jurisdiction. The agencies are Hydrological Services Department under the Ministry of Water Resources, Works and Housing and the Department of Urban Roads, which is an agency under the Ministry of Roads and Highways. The Ministry of Local Government and Rural Development exercises an oversight responsibility over the Accra Metropolitan Assembly and its decentralised departments. In addition, these ministries also make direct budgetary transfers to their sector agencies and the Accra Metropolitan Assembly for the implementation of drainage projects and negotiate for funding for drainage and coastal improvement works. The ministries together with their sector agencies are also responsible for the setting of engineering standards for civil works.

Metropolitan level agencies are the Accra Metropolitan Assembly, Accra Metropolitan Roads Department and Drains Maintenance Unit. These agencies are empowered by Act 462 and other legislations and administrative orders indicated in Figure 6.1 to undertake flood abatement civil works in the Accra metropolis. To achieve their objectives these agencies are expected to share technical information.

At the local level, the actors are community members, community based/development associations as well as local politicians who use formal structures within the Assembly and discursive mechanisms to lobby for projects for their various constituencies. There are also works contractors who implement projects in the various communities. Such entities have informal engagements with the communities but formal lines of command, technical information sharing and funding arrangements with the metropolitan and the national level actors by virtue of contracts with these entities.

In social network analyses, local centrality and 'betweeness' are measures of influence/power of individual actors within a network (Coulon, 2005; Scott, 1987). These visually manifest in network maps as the concentration of lines connecting directly to an actor (point/node). Based on this argument then contractors and the Accra Metropolitan Assembly (General Assembly) will have been the most powerful actors within the network. However, participants at the mini workshop organised as part of this study indicated that the most powerful actor within the network of actors involved in drainage and hydrology improvement in Accra are the financiers (donors).

The stakeholders make the case that project financiers like the World Bank provide funding for most of the drainage projects in Accra. They set the ground rules and scope of works for project design and implementation during the negotiation and appraisal stage of the project. A former senior officer at the Project Support Unit of the Ministry of Local Government and Rural Development alludes to the capacity of donors to influence project choices and outcomes at the inception stage as he recalls that:

"During the UESP II, the assemblies wanted to use the demand driven approach in which they will decide within the framework of their development plans which sub projects to include in each component. The Bank [World Bank] did not agree to this because they felt that some of the projects in the d-plans were not sustainable. In the end we did what they [World Bank] wanted."
[Former Senior Officer at PCU, UESP, Mini workshop Accra. 16th December 2013]

Local level actors have very limited power to influence the project concepts as negotiations are between project financiers, national and metropolitan level actors notably ministers, the Mayor of Accra and strategic level staff in the various sector ministries and decentralised departments. The interest of the financiers and the other actors may not always coincide as indicated above.

Figure 6.2 also illustrates that there is no flow of funds between the Hydrological Services Department, Ministry of Roads and Transport, the Accra Metropolitan Assembly and the Drains Maintenance Unit of the Accra Metropolitan Assembly and Metropolitan Roads Department. This should not have been the case. The problem is traced to power relations between the Ministry of Water Resources, Works and Housing, the Ministry of Roads and Highways and Accra Metropolitan Assembly. A Senior Officer at the Drains Maintenance Unit of the Accra Metropolitan Area explains that:

"At the inception of the Unit it was agreed that a portion of the budget of the Hydrological Services Department and the Road Fund will be seeded off to the Unit annually. Together with allocations from the Accra Metropolitan Assembly, the Unit will undertake routine maintenance works on the city's drainage network. By this arrangement the Metropolitan Roads Department and the Hydrological Services Department were to be relieved off their drainage maintenance functions in Accra so that they are better positioned to deliver on their core mandates of coastal protection, storm drain development and mobility improvement. The issue has discussed at the high levels of government including Cabinet and Parliament. However, the proposal is not in the

interest of the power brokers within the ministries involved. Therefore, no one is pushing for this reform to be carried out" [Senior Officer Drains Maintenance Unit, Accra Metropolitan Assembly, Accra, and Mini Workshop. 16th December 2013]

The statement above suggests that the issue relates to the unwillingness of the Ministry of Roads and Transport and Ministry of Water Resources, Works and Housing to push the agenda. This is primarily because it will lead to a decline in the budgetary allocation of the two ministries. In the public sector, size of budget is source of power (Schiffer, 2007). Hence, the two ministries are not interested in devolving power to a lower entity, which is the Drains Maintenance Unit of the Accra Metropolitan Assembly. This challenge creates duplication of functions among the organisations in drainage improvement and makes the maintenance works more reactive. This is also making the Drains Maintenance Unit ineffective as funds to undertake routine maintenance works on Accra's drainage network has not been forthcoming.

Another weakness observed in Figure 6.2 is in the area of information flow among the Hydrological Services Department, Accra Metropolitan Assembly (Drains Maintenance Unit) and the Department of Urban Roads/Metropolitan Roads Department. By law, the Hydrological Services Department is in charge of supervising the development and maintenance of storm and secondary drains as well as coastal protection works. The Metropolitan Roads Department as metropolitan offices of the Department of Urban Roads is committed to improving urban mobility as enshrined in the vision and mission statement of the Department. In Accra, the Metropolitan Roads Department has supervised the design and construction of secondary and tertiary drains and other drainage infrastructure like culverts. This notwithstanding, the primary function of the Department of Urban Roads and by extension Metropolitan Roads Department remains mobility improvement within the city. Involvement in drainage works is an externality of their mobility improvement function as a road sector agency. A senior officer of the department aptly reiterates this position when he states emphatically that:

"*Drains are not our main focus; we only construct drains to protect our investment in roads. Hydro and MLGRD are mainly responsible for this in Accra." [Interview with a Senior Officer, Metropolitan Roads Department, Accra Metropolitan Assembly, Accra. 10th August 2013*].

This notwithstanding, the Department of Urban Roads and the Metropolitan Roads Department have a history of constructing secondary drains in Accra. For example, a section of the C.B.D drain in Accra was improved under the Urban Transport Project implemented by the Department of Urban Roads. According to an officer of the Hydrological Services Department, the practise has been that works on major storm and secondary drains in Accra undertaken as part of road projects are without the active involvement of the Hydrological Services Department, the statutory body in charge of approvals and the supervision of storm and secondary drainage improvement works in Ghana. He laments:

"Although we participate in statutory planning committee meetings from time to time, our level of involvement in major drainage projects in Accra is limited. DUR and MLGRD construct most of the culverts/drains in Accra without consulting us but when it floods the Minister and everybody is on us." [Interview with a Director of the Hydrological Service Department, Accra. 15th August 2012]

The official goes ahead to indicate some of the risks associated with this practise as the installation of undersized culverts and drains and other design flaws and construction errors, which leads to localized floods. These problems, according to the officer from the

Hydrological Services Department, also exacerbate the severity of flooding during rains. Frimpong (2014) and Karley (2009) explain some effects of design flaws and constructions errors on flooding in Accra. For example, a design flaw at the entry point of the Nima System into the Faanofaa River is partly responsible for flooding in Asylum Down in Accra. In this particular instance, the confluence of two rivers was designed at right angle. Therefore, the larger Faanofaa River slows down the velocity of the smaller Nima system leading flooding (Karley, 2009).

The network of actors involved in drainage improvement in Accra highlights two major challenges in the interaction among the actors. The first borders on the more powerful technocrats and politicians at the national level resisting attempts to devolve power to lower entities within the network, thereby constraining the effectiveness of the Drains Maintenance Unit. Secondly, actors tend to focus on organisational goals thereby creating an organisational culture, which adversely affects power relations between the various public organisations in drainage improvement.

Harries and Penning-Rowsell (2006) notes that organisational culture is a set of beliefs and practises peculiar to institutions that enables them to perform the functions for which they were established. This notwithstanding, strict adherence to these beliefs and practises may not be suitable when dealing with environmental risks like flooding, which require co-operation among actors.

6.3.2 The Network of Actors for Zoning Regulations

In flood adaptation, zoning regulations involves both land use planning and development control to restrict human habitation of flood zones. Actors in this endeavour consist largely of metropolitan and sub metropolitan level actors exhibiting formal and informal ties (see Figure 6.3). National level actors within the network are Ministry of Local Government and Rural Development, Ministry of Environment, Science and Technology, Water Resources Commission as well as the head offices of the Town and Country Planning Department and Environmental Protection Agency. By law, the national level agencies are restricted to policymaking, setting technical standards, monitoring and providing budgetary support to the Accra Metropolitan Assembly, its decentralized departments and the other organisations over which they exercise oversight responsibilities.

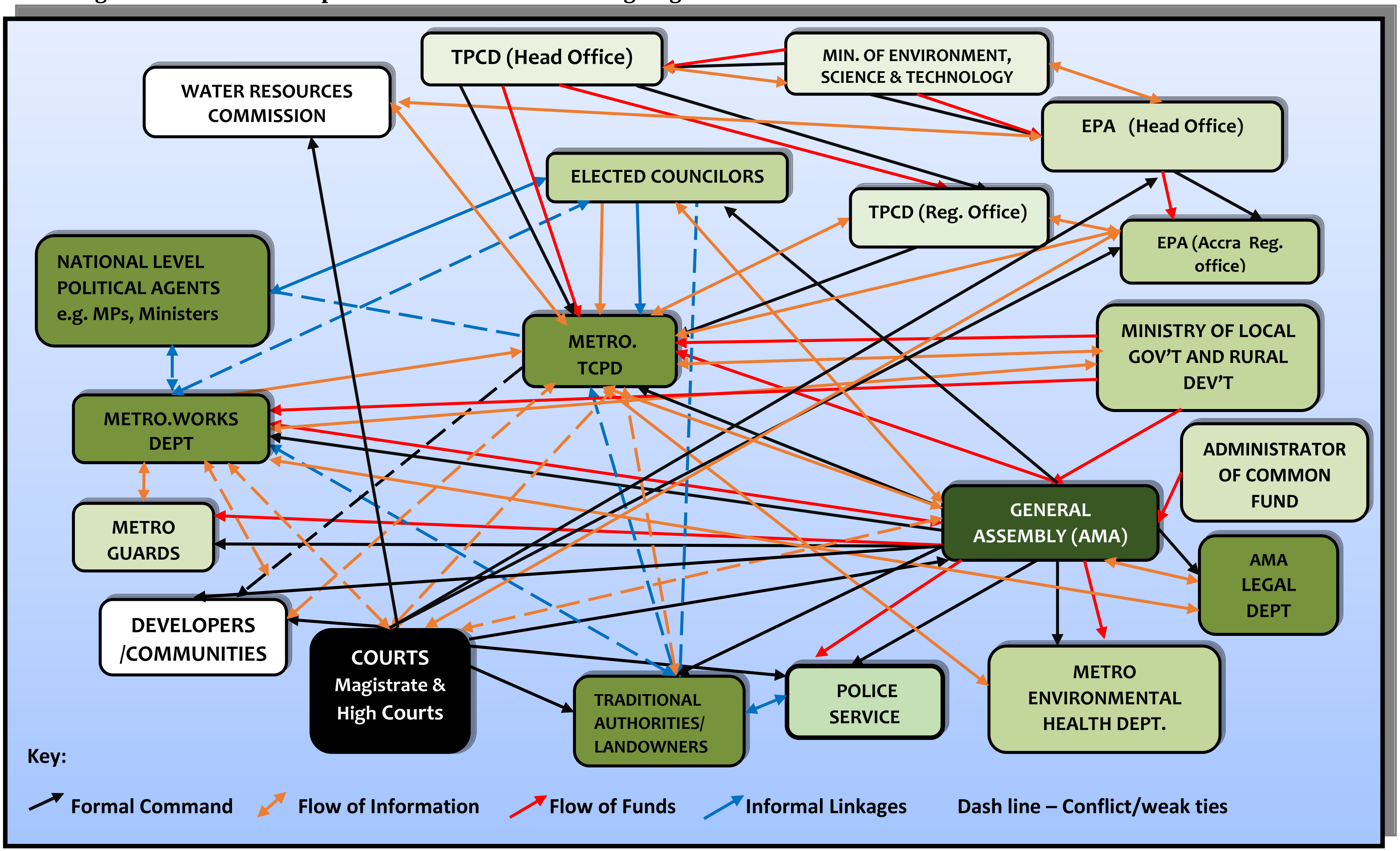
Land use planning and enforcing zoning regulations in Accra are largely within the remit of the Accra Metropolitan Assembly. Decentralised departments of the Assembly directly responsible for these activities are Metropolitan Town and Country Planning Department referred to as the Metropolitan Physical Planning Department and Metropolitan Works Department. Two committees of the general assembly are also important in development control in Accra. These are the Works and Statutory Planning committees while the Statutory Planning Committee deals with issuing building permits, the Works Committee deliberates and proposes byelaws to regulate civil works for the consideration of the general assembly.

The authority of the Assembly and all other stakeholders are subject to that of the judiciary. Section 23 of the 1992 Constitution of the Republic of Ghana affords persons aggrieved by actions and decisions of the Assembly and its decentralized departments the right to seek redress in the law court. The city planning authority by law must obtain eviction notices from the court before they can remove unauthorised structures from waterways and wetlands. This makes the courts the most powerful actor in the network. Officials of the planning authority argue that courts have been placing injunctions on proposed demolishing exercises by the Accra Metropolitan Assembly. These injunctions, according to representative of the Metropolitan Town and Country Planning Department at the mini-workshop, “make it impossible for the Assembly to remove obstructions in waterways that causes flooding in Accra” [Senior Officer Metropolitan Town and Country Planning Department, Accra Metropolitan Assembly, Accra, and Mini Workshop. 16th December 2013].

The courts, however, claim that they have to follow due process.

Traditional authorities in the form of families or clan heads and chiefs, local and national politicians are the informal actors in the network (see Fig. 6.3).

Figure 6.3: Network Map of Actors Involved in Zoning Regulation for Flood Risk Reduction



*Darker background colours represent more powerful/influential actors **Dash lines represent weak relationships

Figure 6.3 is indicative of the weak ties between informal and formal actors in the network. The conflict between the Assembly (including its decentralised departments) and traditional landowners in Accra on the issue of land use planning and enforcement of zoning regulations on wetlands and reservations around watercourses exemplifies this challenge.

The traditional authorities have allodial interest in land and they draw influence (power) from customary land laws. Customary land laws are embedded in social customs, norms and traditions (Yeboah and Shaw, 2013). In the customary land ownership system, land belongs to kinship groups consisting of ancestors, the living and generations yet unborn (Aryeetey-Attoh, 1997). Clan and family heads as well as chiefs hold land in trust of the kinship group. Ghanaian statute upholds the concept of trusteeship in land (see Article 172 (1) of the 1969 Constitution and Article 36(8) of 1992 Constitution of the Republic of Ghana) and placing large tract of land in Accra and Ghana[8] under customary landowners (Grant and Yankson, 2003; Kassanga and Kotey, 2001; Tipple and Koboe, 1998; Aryeetey-Attoh, 1997). This implies that traditional authorities in the form of family and clan heads and chiefs control a large chunk of the land holdings in Accra.

For the traditional authorities the meaning of land ownership includes the power to determine land use, transfer ownership and enjoy usufruct rights. These rights accrue immense economic benefits to the trustees under the current neo-liberal economic

[8] Kassanga and Kotei (2001) indicate that 80% of Ghana's landmass is customary land. In Accra, there is some ambiguity about the exact proportion of customary land. While Grant and Yankson (2003) put the proportion at 89%, Tipple and Koboe (1998) and Aryeetey-Attoh (1997) simply mention that proportion is large. The challenges associated with establishing the exact proportion of land under various tenure in Accra is linked to the difference in the boundaries of Accra at various points in time.

environment in which communal land has become 'commoditised'. Rapid urbanisation in Accra has created a huge demand for land in the city and given supply, unit prices are rising. Juxtaposing this situation with the declining livelihood opportunities for the Ga people, wetlands and reservations have become hotspots in the land market. These sites are relatively affordable for poor households who are priced out of the formal land and housing markets. For this reason, leasing out wetlands and reservations has now become a livelihood strategy for the landowning class as well as a coping strategy for the poor in Accra who form the bulk of developers within the informal sector.

Formal agencies like the Environmental Protection Agency, Water Resources Commission, Accra Metropolitan Assembly as well as the Metropolitan Physical Planning Department and Metropolitan Works Department interpret land use and land ownership differently. The formal agencies hold the view that customary land ownership is vested in traditional authorities but the law empowers them to determine land use. That is, their establishing Acts and the Local Government Act of 1994 (Act 462) give them the mandate to enforce zoning and building regulations in the public interest. The representative of the Metropolitan Town and Country Planning Department at the mini-work aptly articulates this position during discussions on this issue. He forcefully argues,

> *"I will refer you to Section 61 of Act 462 where there is clarity on this matter. Any allocation of land or sub division without the approval from the Assembly that contravenes the proposals in a plan or scheme is void. So land owners cannot determine the use of land by themselves."* [Senior Officer Metropolitan Town and Country Planning Department, Accra Metropolitan Assembly, Accra, and Mini Workshop. 16th December 2013]

The different meanings assigned to the concept of land use by the traditional landowning class and officials of the metropolitan planning authority is a major challenge for flood zoning in Accra as the traditional land owners are not part of the local government set up[9]. Deepening this challenge is the scarcity of information on land use planning and development control like demarcated flood zones and the fact that these information largely circulates among formal actors.

Political interference in enforcement of zoning regulations also adversely affects flood alleviation in Accra. The story of a building inspector in charge of a flood prone community illustrates how metropolitan and national level politicians use their power to influence land use planning decisions at the community level. The building inspector claims,

> "*We undertook an operation at Sakaman [a suburban of Accra] to prevent development in a watercourse. We seized some equipment from the developer. A few days later, my [former] boss called me and asked me to bring the equipment to his office. Later that day we drove in his pick up to give the equipment back to the developer in his house. My boss told me it was 'order from above'. I didn't ask any question again."* [A Building Inspector, in a poor Sub Metropolitan Area in Accra. Mini Workshop 16th December, 2013].

A senior officer at the Drains Maintenance Unit also alludes to local political interference in development control and perceives that some material benefits accrue from it to the political elite at the community level. He notes,

> "*There has been an occasion when the building inspector of the area [Mpoase/Glefe/Panbros] has complained to me that he went to do some work in the area and had some confrontation with the Assemblyman. The Assemblyman lives in those conditions and maybe he gets something [money] out of these things [improper siting of structures]"* [Senior Officer, Drains Maintenance Unit, Accra Metropolitan Assembly, Accra. 20th August, 2013]

[9] Chiefs can only be part of the local government structure if they are appointed by central government as part of the one-third government appointees that constitute the general assembly of district, municipal and metropolitan assemblies.

The technocrats in most cases bend under the political pressure because it enhances the social network between them and the political class. For the politicians the driving force behind interfering in local land use planning decisions is to court constituents for electoral votes and thereby enhancing their chances of achieving their private goal, ascending to or remaining in power.

Finally, the interaction between the officials of the Accra Metropolitan Assembly and communities is characterised by mistrust and resentment of officialdom by the residents of flood prone communities. This is because the communities perceive that officials of Accra Metropolitan Assembly and the traditional land owning class have connived to lease out the wetlands to prospective developers, hence their current predicament (flooding of their homes).

During the focus group discussions at the community level, residents in all the study communities levelled various allegations of corruption and apathy against officials of the Accra Metropolitan Assembly. One opinion leader in Agbogbloshie had this to say on the reasons why development control had failed in his community during the mini-workshop.

"My brother let's speak the truth when you report of encroachment to the Accra Metropolitan Assembly, the officials come and mark the building but the developers 'go and see'[bribe] the officials and nothing happens." [Mr. Boateng, Opinion Leader Agbogbloshie, Mini-workshop 16th December, 2013,].

Another comment from a member of the focus group at Glefe West supports the view expressed by the opinion leader from Agbogbloshie, which sums up residents perception about public officials at the Accra Metropolitan Assembly. He emphatically states, *"Today, there are no 'elders' in Ghana. They all take money and pretend they do not see what is happening. When you see somebody doing the wrong thing and you report to the authorities, the AMA people come around, take money and nothing happens. If you are not lucky, they [the officials] will point you out and you will be attacked*." [Michael Agyare, A 39 year Old Resident of Glefe West, Accra. 2nd June 2013].

Most Ghanaians share the perception that public officials are corrupt. Ghana's persistent score of below four (4) out of clean score of ten (10) on the corruption perception index by Transparency International is ample evidence of the public perception of the pervasiveness of corruption within officialdom (Transparency International, 2010). A survey of 334 households in flood prone communities in Accra also alludes to corrupt practises in enforcement regimes that regulate zoning in Accra and its association with increased flood risk. In the survey, 16% of the respondents indicated that corruption in official circles exacerbated flood risk in the city (Frimpong, 2014).

In Agbogbloshie, the community members attribute the neglect of their community by the Accra Metropolitan Assembly to apathy in addition to corruption. This perception according to the group of community leaders interviewed was because of the proximity Old Fadama and the Agbogbloshie market. A community leader in the focus group discussion perceives that, "When we mention Agbogbloshie people think it is the market but we were here before the market. Then there is the problem of Sodom and Gomorrah. But we are different. They are Kokombas and we are not." [Musa, 39 years, Youth Leader Agbogbloshie, 14th July 2013].

Two reasons inform the negative perception about any association with Old Fadama especially from the planning point of view. First is the failure of previous planning interventions in Old Fadama under the Korle Lagoon Ecological Restoration Project due to the planned forced eviction exercise. This stack reality is enough to engender inertia on the part of any city planner with good intentions of using zoning regulations for the purposes of flood alleviation in Agbogbloshie.

Secondly, the notion that the area is public land evaded by squatters that will be reclaimed in the future by the Metropolitan Assembly implies that Agbogbloshie township will not feature in any short to medium planning proposal in Accra aimed at improving the lot of the residents. Finally, the confusion of Agbogbloshie Township with Agbogbloshie market, a regional market, oblivious of its status as residential area means that the community will be ignored in the provision of amenities like drains, which are necessary for flood abatement. Under these conditions, the public mistrust for officialdom is to be expected.

The representatives of planning authorities, however, paint a picture of residents who are not willing to support the metropolitan assembly in its development control functions. A story by the Assemblyman responsible for Glefe and Mpoase (Gbugbe Electoral Area) sums up the level of hostility towards officialdom in these communities. He narrates how a group of assailants assaulted a man mistakenly identified as him because they felt he had reported the development of an unauthorised structure in a watercourse to Accra Metropolitan Assembly task force for demolishing [Assemblyman, Gbugbe Electoral Area, Accra. Mini-workshop 16th December, 2013].

From the discussions above, the weakness in the ties between poor urban communities in Accra and the Accra Metropolitan Assembly together with its decentralised departments involved in zoning regulation is also due to mistrust. This has been re-enforced by a series of negative encounters between community members and public officials. This situation mimics a classic case of 'multiple realities' at the interface (Long, 1999). Public officials perceived the study communities as inaccessible and hostile while the community members accuse the public officials of neglect and corruption. This cycle continues and re-enforces itself over time creating inertia on the part of public officials and blurring the possibility of co-operation from the communities in the area of enforcing zoning regulations.

Another area of conflict in network for zoning regulation is between the traditional land owning class and the officials of the metropolitan authority. Underlining this conflict is legal pluralism. Legal pluralism is a phenomenon in which numerous, contradictory and competing sets of rules and norms regulate social, economic and political relationships at the local level (Aldier et al. 2008). Existing side by side at the community level is customary land laws and statutory planning laws. These laws are interpreted differently by the land owning class and public officials when it comes to the concept of land use. Legal pluralism can enhance adaptive capacities in the face of ecological and livelihood uncertainties (Meinzen-Dick and Pradhan, 2002; Ngaido and Kirk, 2000). However, as indicated in this case, it can also be a deterrent to adaptation to urban floods. This occurs when different actors draw on different legal regimes (customary and statutory) co-existing at the community level to appropriate the power to determine land use. The ensuing 'contest' undermines efforts to enforce zoning regulations within wetlands in Accra.

6.4 Major Flood Alleviation Projects in Accra

The state implements flood adaptation measures aimed at reducing exposure to flooding in the city of Accra. Discussions with the experts in the public sector point to the fact that three major flood alleviation projects have been implemented in the city in the past three decades. These are the Korle Lagoon Ecological Restoration Project (KLERP), Urban Environmental Sanitation Project (World Bank Urban-IV) and Second Urban Environmental Sanitation Project (UESP-2). These major projects are reviewed in order to understand the actions of national and metropolitan level actors in flood adaptation.

6.4.1 Korle Lagoon Ecological Restoration Project

The Korle Lagoon Ecological Restoration Project (KLERP) worth US$ 89.52 million was implemented with funding from the Kuwait Fund, OPEC Fund, and the Arab Bank of Economic Development in Africa. The project was formulated in response to the high levels of siltation and pollution in the Korle Lagoon, which were believed to be the cause of loss of livelihood and flooding in the Odaw catchment. The objectives of the project were to restore the lagoon to its natural ecology, realign the lagoon to improve its hydrological efficiency so as to increase the flow of the water through the lagoon and finally to develop it into a major tourist attraction (Boadi and Kuntinen, 2002).

The project was to be implemented in four phases. Phase one consisted of dredging of the Korle Lagoon, creating storm water channels, disposal of spoil material, removal of swamps to reduce flooding, creation of green areas and capping dump areas. For the second phase an interceptor, pumping station and a 1.5 kilometres outfall to discharge treated dry weather flows into the sea were to be installed together with ancillary civil works. Phase three of the project involved sediment removal and re-dredging of the lagoon as well as tributary canals and drains. Finally, the project was to construct bulk infrastructure like roads, sewers and electrical installations and remedial actions in the environmental impact assessment during the final phase of the project.

The expected completion date was December 2003 (Armah et al. 2009). Between 2000 and 2003 phase one of the project was completed whereas phase two was completed in 2005. The third and final lots were never completed because the planned relocation of residents of Old Fadama and Agbogbloshie, which will have made land available for the implementation of these two phases, were not implemented. The implementing agencies were the Ministry of Works and Housing, Ministry of Tourism, Modernisation of the Capital City and the Accra Metropolitan Assembly. Key actors in the project, their interests, and level of engagement during project design and implementation are summarised in the Table 6.1.

Table 6.1: Stakeholder Interest in the Korle Lagoon Ecological Restoration Project (KLERP)

Stakeholders	Interest	Level of Consultation
Residents of Old Fadama/Agbogbloshie	Occupants of lands within the Project Zone. Disposal of waste into the Odaw River which flows into the Korle Lagoon Derives livelihood from trading activities in Yam market and Agbogbloshie markets Reduction in flood related damages	No/Passive*
Accra Metropolitan Assembly	Ecological restoration of the lagoon Economic benefits Land use changes in the project zone to beautify the city Flood Mitigation	Active
Gbese and Korle Dudor Clans	As traditional authority of the lagoon region their interest was the cultural value of the lagoon (performing of rites) Customary land rights Regeneration of livelihood activities (fishing) after the project	Active
Ministry of Tourism and Diaspora Relations	Economic benefits through development of leisure facilities around the banks of the lagoon Land use changes to beautify the city	Active
Ministry of Works and Housing	Ecological health of the lagoon Altering the land use and activities around the lagoon Flood Mitigation	Active
Environmental Protection Agency	Ecological health for the project zone	Active
NGOs COHRE, Centre for Public Law (CEPL)	Economic and economic empowerment of residents of Old Fadama (Sodom and Gomorrah) Land and shelter right of the squatters of Old Fadama	Active
Ministry of Local Government and Rural Development	Ecological health of the lagoon Altering the land use and activities around the lagoon	Active

Source: Adopted from Armah et al. (2009) * After 2007

Table 6.1 shows that during the project conception and implementation stages residents of Agbogbloshie and Old Fadama were not consulted. Armah et al. (2009:83) confirms this position as they report that:

> *"respondents were unanimous that local authorities before January 2007 did not invite Old Fadama community members or their representatives to any forum or meeting concerning the management of the lagoon ..."*

The underlying reason for the lack of involvement of residents of Old Fadama and Agbogbloshie was fixation of national and metropolitan level actors to use the Korle Lagoon Ecological Restoration Project (KLERP) to evict the residents of the two communities. Government officials, at the time referred to residents of the Old Fadama as squatters, illegally occupying public land, undermining efforts to modernise the city. The settlement was referred to as “Sodom and Gomorrah” to give an anti-social labelling and create public disaffection towards its residents (Afenah, 2009; COHRE, 2004; Kuitunen and Boadi, 2002). Apart from this, the ‘squatters’ were tagged by authorities as the major polluters of the lagoon though subsequent studies by Centre on Housing Rights and Eviction (2004) and Boadi and Kuitunen (2002) proved otherwise.

By networking with international and local non-governmental organisations namely Centre on Housing Rights and Eviction (COHRE) and Peoples Dialogue on Human Settlement respectively, the residents of Old Fadama mobilised and contested the planned forced eviction by the government through political means. The residents proved to the government that the community was a viable political constituency with a population of 35,000 of which 20,000 were eligible voters (Grant, 2006). This forced the government of the day, the New Patriotic Party (NPP) to delay the implementation of the planned forced eviction exercise even after the residents’ application for an injunction was denied by the court. Currently, the two major political parties in Ghana, the ruling National Democratic Congress (NDC) and New Patriotic Party (NPP), are active in Old Fadama, maintaining constituency branch offices in the community, casting doubts about any eminent eviction.

The planned forced eviction together with the stigmatisation and marginalisation of residents of Old Fadama created disaffection and antagonism towards the Korle Lagoon Ecological Restoration Project among the residents of Old Fadama and

Agbogbloshie (Armah et al. 2009). The inability of Government to relocate the community and make land available for the project resulted in delays and cost overruns and the eventual force majeure in 2009.

6.4.2 Urban Environmental Sanitation Projects (UESP-1 &2)

The Urban Environmental and Sanitation Project (UESP-1) was implemented in Accra, Sekondi-Takoradi, Tamale, Tema and Kumasi to the tune of US$89 million. Of this amount 17 US$ million was spent on storm drainage works in Accra (World Bank, 2004). The project had five components of which three namely, storm drainage, refuse management and community upgrading, directly responded to the problem of urban floods in the city of Accra. Of the three project objectives, the one that sought to promote productivity and raise living standards in Ghana's major cities, especially for lower income people, by improving drainage, sanitation and solid waste services related to adaptation to urban floods in Accra.

Flood adaptation measures implemented under this project in Accra were the dredging and construction of 7 kilometres of the Odaw drain from the Abossey Okai road to Motorway Extension into a trapezoidal drain. Another 20 kilometres of secondary drains were constructed in three low-income communities, namely, Teshie, Sukura, and Maamobi to alleviate flooding problems for 20,000 households as part of the community infrastructure-upgrading component (The Consortium, 2003).

The Second Urban Environmental Sanitation Project (UESP-2) was a 'repeater project' meant to scale up investments under the Urban Environmental Sanitation Project (UESP-I). This project was jointly financed by the World Bank, Agencies

Development Franciase (AfD), Nordic Development Fund and the Government of Ghana. Like its precursor, the project was also implemented in Accra, Kumasi, Sekondi-Takoradi, Tema and Tamale with the overall objective of improving the urban living conditions in regard to environmental health, sanitation, drainage, vehicular access and solid waste management in sustainable fashion with special emphases on the poor (World Bank, 2004). The total project cost was US$62 million of which US$19.3 million was spent in Accra.

Component 1 of the project dealt with the provision of storm drains and its objective was to "reduce flooding severity and duration of flooding in low lying areas" (World Bank, 2004:26). To achieve this objective in Accra, the Mataheko (1.1km), Onyasia (1.4km) Chemu (3.75km) drains were constructed together with priority secondary drains in the East Chemu basin (7.8km). As part of the community-upgrading component, 15,800 households in three selected depressed residential areas in the city of Accra benefitted from a menu of secondary drains and other basic housing infrastructure (World Bank, 2004). To resolve the ambiguities in funding arrangements and co-ordination of drainage maintenance works in Accra, a Drains Maintenance Unit was established under UESP-2 (Work Bank, 2004).

The key stakeholders in Accra were the donors led by the World Bank, Ministry of Local Government, and Rural Development, The Accra Metropolitan Assembly, Environmental Protection Agency, community leaders and households in the beneficiary communities.

The project did not include a city wide awareness campaign to raise sensitise residents about flooding and its adverse impacts in Accra though reducing exposure and vulnerability to flooding was a major objective of the project. Awareness creation under the USEP 1 & 2 was geared towards creating demand of the subsidized household latrines under the sanitation component and property owners whose properties were to be expropriated as part of the drainage and other civil works (World Bank, 2004).

The discussions so far point to the fact that all the three projects involved complex civil works without complementary non-structural measures for flood alleviation. None of the projects had components like awareness creation on proper refuse management and assisting the Accra Metropolitan Assembly in its land use planning and development control functions though these issues are at the heart of flooding in Accra.

Engineering solutions dominate public adaptation to floods in Accra at the expense of non-structural measures. This is because the capitalist-modernity discourse frames public flood adaptation actions in the metropolis. Embedded in this discourse is the hazard centred paradigm, which enjoys wide acceptability among engineers and other technocrats. The directors of Hydrological Services Department, Metropolitan Roads Department and the Drains Maintenance Unit are professional engineers. Apart from the dominance of engineers and technocrats in flood management in Accra, pressure from residents in depressed flood prone communities and the huge drainage infrastructure deficit in Accra also contribute to the demand for structural measures.

These large-scale engineering projects also facilitate neo-patrimonial governance arrangements (Adler et al. 2008) that further the careers and provide financial rewards for technocrats and political elites at the national and metropolitan levels. Ghana's construction sector is rife with patronage systems. Anecdotal evidence suggest that most contracts are bloated because contractors are obliged to pay 10% of the value of the contract as kickbacks into the coffers of the ruling party (Centre for Democracy and Development, 2000).

Compared to structural measures, the outcomes of implementing non-structural flood adaptation measures like enforcing zoning regulation are hardly tangible and come with a high political cost. Afenah (2009) and Grant (2006) explain the role political considerations played in delaying the planned forced eviction of the residents of Old Fadama during the Korle Lagoon Ecological Restoration Project even after a high court ruling dismissed the application for an injunction by the residents. The delay forced eviction ultimately led to the force majeure in 2009.

Several scholarships have underscored the role of social networks and local knowledge in public adaptation (Adger, 2003; Berkes, 2002; Olsson and Folke, 2001). Berkes (2002) makes a case for integrating local knowledge and formal flood management systems across scales. The three projects discussed above show that flood abatement projects in Accra have not accommodated local interest and knowledge. Implementation has also made little room for building networks across formal and informal actors at the local level.

These observations are indicative of the fact that very little social learning has occurred within the public institutions involved in public flood adaptation in Accra. In urban flood management, social learning is defined as ‘‘the diversity of adaptations, and the promotion of strong local social cohesion and mechanisms for collective action’’ (Adger et al. 2005:1038). It occurs when institutions formalise beneficial impromptu actions for handling future events.

6.5 Community Level Adaptation Actions

Community level adaptation actions in the study communities can be linked to local knowledge domains on the causes of flooding. The actors are the traditional authorities in the various communities, local politicians (elected councillors) and Community Based Organisations. Of these actors, Community Based Organisations are the most active agents in terms of flood adaptation. The Glefe Community Development Association[10] is the only Community Based Organisation involved in flood adaptation actions in Glefe while in Mpoase, there was no community-based organisation involved in flood adaptation actions during the time of the study because

[10] Formed on 17th July 2011 with fifty-two (52) members, the Glefe Community Development Association also referred to as the Glefe West Development Association, currently has three hundred and seventy two members with a chairperson, treasurer and secretary elected to run a four-year term. The association has not been formally registered with the Department of Social Welfare but formal notification about their objectives and activities has been served on the district police command at Dansoman, the traditional authority and the Member of Parliament of the area as well as the elected councillor (Assemblyman). The association’s objectives are anchored on community mobilisation and lobbying for development projects, addressing the deficit in social amenities, enhancing human security in the community and fostering volunteerism and a communal spirit. Thus, one can conclude that the association was formed to mobilise the community to press officialdom to address the numerous development challenges facing inhabitants of the community, flooding inclusive. A review of formal communication between the association and government agencies however points to an emphasis on flood alleviation and sanitation improvement as focal areas of their activities (see Appendix C for letters).

residents tend to benefit from the externalities of any intervention to resolve flooding in Glefe because they are upstream the Gyatakpo Lagoon. In Agbogbloshie, the Agbogbloshie Landlords Association[11] uses its customary powers to prevent unauthorised siting of structures and mobilise the community for communal labour to desilt choked drains with very little success.

The modes of adaptation are engaging in communal labour to desilt drains and Gbugbe estuary in the case of Glefe and engaging city authorities and corporate entities through writing letters and holding meetings to discuss the problem of flooding in order to come out with possible solutions. Among these activities, engaging officialdom and corporate entities for flood alleviation projects is the most visible form of community level adaptation actions in the study communities. The communities rarely organise communal labour to desilt the few secondary and tertiary drains and clean up the environment. The nature of engagements with public and

[11] The Agbogbloshie Landlord's Association was formed in 2010 in response to a threat of forced eviction after clashes between loyalist of the two biggest political parties in Ghana, the New Patriotic Party (NPP) and National Democratic Congress (NDC), in nearby Old Fadama and the Agbogbloshie Market in August 2009. The association is registered under the Ghana Federation of the Urban Poor (GHAFUP). The association started with forty-six (46) members but the number has reduced considerably to ten as at the last meeting in January 2014. Although contesting forced eviction is its main priority, the association uses its customary powers to mobilise the community to cope with urban floods, albeit a lot of difficulty. For example, after two rain storms in June 2014, the association together with the Assemblyman of the area organized a clean-up exercise to desilt gutters and clean the community in order to reduce the impact of future floods in the rainy season. The association also deals with issues of improper siting of structures, though with very little success. There are plans to set a up a climate change adaptation club in Agbogbloshie under the Climate Change Adaptation Research and Training for Capacity Development (CCARTCD) project jointly implemented by the Regional Institute of Population Studies of the University of Ghana and International Research Development Centre. The club will increase awareness about climate change and improve adaptation to climatic hazards in the community. Under the project, the community will also benefit from a 1.4 kilometre concrete drain to reduce exposure to urban floods. The club will be in charge of maintenance of the drain when completed.

corporate entities for flood alleviation projects are presented as the thrust of community based adaptation actions.

6.5.1 Glefe Community Development Association versus Panbros Salt Manufacturing Company Limited

Glefe Community Development Association is a community-based organisation with the objectives of community mobilisation and lobbying for development projects and programmes for Glefe. Panbros Salt Manufacturing Company Limited is a large-scale salt processor with a concession in the Densu Wetlands; West of Accra near Glefe and Mpoase (see Figure. 5.1).

The ‘struggle’ between Panbros Salt Manufacturing Limited and the community leaders of Glefe under the umbrella of the Glefe Community Development Association began with the flood event of October 2011. During that flood event, the community leadership led by the Assemblyman took a spontaneous decision to use communal labour to breach the embankment erected by Panbros Salt Manufacturing Limited to protect its salt ponds from contaminated flows from the Gyatakpo and Gbugbe lagoons (Ref. Figure 5.1 for location of the embankment). This action was to facilitate the rapid draining of storm water out of the community because, as previously indicated, the community leaders perceive that the embankment impedes storm water conveyance and hence exacerbates flooding in Glefe. As the only zone of weakness in the embankment was the cross culvert constructed by Panbros Salt Manufacturing Limited to drain excess seawater from their operations into Gyatakpo lagoon, the fill material was removed from the culvert to allow storm water to flow out of the lagoon through the Panbros salt ponds to the relief of the community.

The breaching the embankment by the residents of Glefe did not go down well with officials of Panbros Salt Manufacturing Limited because their industrial salt manufacturing process was truncated and processed salt was lost. The company responded by re-enforcing the embankment and the culvert against future communal action. Therefore, the community could no longer open the culvert during floods to bring them the much-needed relief.

Not being able to breach the embankment during subsequent floods, because the culvert has been re-enforced by Panbros Salt Manufacturing Limited, the community leaders in Glefe and Mpoase attribute the worsen flooding situation in their communities largely to the creation of the embankment and diversion of the estuary of the Gyatakpo Lagoon. So on 29th February 2012, the Glefe Community Development Association sent a proposal to Panbros Salt Manufacturing Limited on behalf of the community. The proposal explained how the diversion of the Gyatakpo Lagoon and the construction of the levee (embankment) were adversely affecting Glefe and Mpoase in terms of flooding. In the proposal, the association also presented alternative sketch designs for the re-engineering of the Gbugbe estuary and re-aligning the embankment based on their understanding of the situation and historical antecedents (see proposal in Appendix C).

Panbros Salt Manufacturing Limited did not respond to the February 29, 2012 proposal, so they were issued with a reminder on 24th April, 2012. The formal remainder was copied to the District Police Command, Member of Parliament for Ablekuma South Constituency and Assemblyman of the Gbugbe Electoral Area as well as the Sub Metropolitan Director, Ablekuma-South Sub Metropolitan Area. The reminder subtly warned of an impending civil action if their proposal went unattended.

Sensing the gravity of the situation, officials of Panbros Salt Manufacturing Limited called for a meeting between the two parties to discuss the issues raised in the association's proposal. The two parties could not resolve the issue at the first meeting but there was an agreement to meet bi-weekly to negotiate a peaceful solution to the impasse. After four months of dialogue, optimism turned into fatigue and the association decided to abandon the bi weekly meetings because according to one of the executives, "nothing good was becoming out of these meetings." [Mr. Osei, Executive, Glefe Community Development Association, Glefe-Accra. 3rd July 2014]. Since then the association has threatened to seek redress at the court but because of lack of funds to pay legal fees they have not been able to carry out this threat.

As indicated in chapter five, the leaders of Glefe and Mpoase are of the view that the activities of Panbros Salt Manufacturing Limited are a major cause of flooding in the two communities. In view of this, the association contends that the company must finance the re-engineering of the Gyatakpo estuary and the re-alignment of the embankment. This according to the executive interviewed "is the only way to deal with flooding in the community." Panbros Salt Manufacturing Limited sees otherwise.

An official of Panbros Salt Manufacturing Limited interviewed as part of this study also feels that his company is being antagonised unduly. In his view, the company already undertakes the dredging of the Gyatakpo Lagoon estuary at the onset of the rainy season as well as during floods. The company, he also contends, provides employment for the youth of the communities within its catchment including Glefe and Mpoase. The company's is that because the communities have developed and encroached on the Densu Wetland and portions their concession they also suffer from flooding which contaminates and destroys the salt they produce hence the decision to construct the embankment. He goes on to mention that the company has offered to support efforts to improve sanitary condition in Glefe and its environs by providing them with skip pads and access roads to dump sites once the communities procure skip containers from the Accra Metropolitan Assembly. The representative of the Glefe Development Association interviewed during the study also confirmed this promise.

In support of the case of Panbros Salt Manufacturing Limited, the officer indicated that the annual production of salt hovers around 45,000 tonnes but this reduces to less than 23,000 tonnes when a major flood occurs in a particular year [Senior Manager, Engineering, Panbros Salt Manufacturing Limited, Accra. 14th May 2014]. Under such conditions, the company does not feel obliged to undertake any additional capital-intensive investment to reduce the incidence of flooding in Glefe, Mpoase and the other surrounding communities apart from dredging the Gyatakpo estuary ahead of the rainy season.

Notwithstanding the fact that their main reason for engaging with Panbros Salt Manufacturing Limited was not achieved, the Glefe Development Association has succeeded in making Panbros Salt Manufacturing Limited commit to the construction of skip pads and access roads to refuse collection points in the community if the community procures skip containers from the Accra Metropolitan Assembly.

6.5.2 Glefe Community Development Association versus the Mayor of Accra

The Glefe Community Development Association has also written several letters to the Member of Parliament for Ablekuma South Constituency, the Sub Metropolitan Director - Ablekuma Sub Metropolitan Area and the heads of the Hydrological Service Department and Accra Metropolitan Roads Department (Appendix C for some of the letters). The letters inform the public officials about the flooding problems of the community and request drains and sea defences to minimise the impact of inland floods and tidal wave attacks on the community (see Appendix C for sample letters). Subsequent to these letters, officials of these organisations have held follow up meetings with executives of the association to discuss the problem.

The Member of Parliament of Ablekuma South Constituency and officials of the Accra Metropolitan Assembly including Mayor of Accra [12] visited Mpoase and Glefe after October 2011 floods as part of their tour of affected communities. The Mayor also went to campaign in Mpoase and Glefe during the run up to the 2012 presidential and parliamentary elections. On both occasions, the Mayor promised that the Accra Metropolitan Assembly would provide drains in Glefe and Mpoase to minimise flooding in these communities.

After the flood of 6th June 2014, the Mayor of Accra together with the Greater Accra Regional Minister and other officers of the Accra Metropolitan Assembly, visited Glefe and other affected communities to assess the extent of damage. The

[12] The Mayor of Accra is the Chief Executive of the Accra Metropolitan Assembly. District, municipal and metropolitan chief executives are appointed by the President but they can assume office only if they secure two-thirds of the votes from elected councilors (Assemblymen/women) and government appointees who make up the general assembly.

communities issued threats to demonstrating[13] against the Mayor and the Member of Parliament if by their next visit to the area there are no visible signs of an intervention to resolve the flooding problem in the area. According to the executive of the Glefe Community Development Association, “we [the community] made him [the Mayor] understand that the 2016 elections were not far away and if he does not do anything about the flooding he should not step here to campaign.” [Mr. Osei, Executive, Glefe Community Development Association, Glefe-Accra. 25th July 2014].

The Mayor under a lot pressure to act promised to take some immediate actions to minimise the impact of flooding on the residents of Glefe and its environs. Five days later storm water from another heavy downpour and the spilling of the Weija Dam upstream inundated Glefe and Mpoase. The media showed footages of the devastation in Glefe, Mpoase and other communities downstream the Weija dam. Two weeks later work on community drains in Glefe began. The Accra Metropolitan Assembly finally provided funding for the commencement of drainage works to minimise the impact of flooding in the community in fulfilment of the Mayor’s promise.

From the foregone, community-based organisations formed to promote the welfare of the residents, champion community level adaptation actions in low-income

[13] Demonstrations and threats to demonstrate as well as threats to vote against politicians or political parties are used by the urban poor or rural dwellers to press officialdom for basic amenities in their communities normally when they feel that all other political processes have been exhausted. For example, the 26th July, 2014 edition of the Daily Graphic newspaper reported a violent demonstration in Ashiaman, low income urban community near Accra, against the central government and Ashiaman Municipal Assembly for failing to act on the deplorable conditions of local roads in the community. In most cases, public officials respond favourably to the demands of the agitating communities especially if those areas are perceived to be strongholds of the ruling party or a particular politician in power. In the case of Ashiaman, improvement works on the community roads resumed after the demonstration by residents and motorists.

communities in Accra. In the case of the Agbogbloshie Landlords Association, it was to resist forced eviction by the state while the Glefe Community Development Association seeks to mobilise the community for development and ‘pressurise’ the state to provide urban infrastructure and municipal services in the community. These suggest a strong attachment of the community based organisations to their communities rather than to the nation state. This phenomenon is an emerging trend in the political economy of urban areas. In this new movement, the concept of citizenship is being re-scaled, re-territorised and re-oriented away from the traditional Westphalian citizenship with its state hegemony (Purcel, 2003).

Furthermore, the position of Soderbaum (1993) that worldview of actors relates to their perception of what constitute a problem as well as solutions to the perceived problem, is also confirmed by the activities of the Glefe Community Development Association. In the previous chapter, community leaders in Glefe and Mpoase mentioned the activities of Panbros Salt Manufacturing Limited, namely the construction of the embankment and diversion of the estuary of the Gyatakpo Lagoon, as a major cause of flooding in the two communities. This perception explains the position of the Glefe Community Development Association that the solution to flooding in Glefe and Mpoase lies in Panbros Salt Manufacturing Company Limited re-engineering the Gyatakpo estuary and the embankment.

The outcomes of the narratives on community level adaptation actions show evidence of ‘dialectics of control’ (Giddens, 1984). Giddens conceives power as a two-sided phenomenon of dependence and autonomy. He also emphasises that subordinates in power relations are capable of influencing the actions of more powerful actors. Giddens (1984:16) states:

"Power within social systems that enjoy some of continuity over time and space presumes regularised relations of autonomy and dependence between actors or collectives contexts of social interaction. But all forms of dependence offer some resources whereby those who are subordinate can influence the activities of their superiors."

In the first narrative, residents of Old Fadama and Agbogbloshie from their subordinate position were able to use discursive means to overturn the decision of the state to evict them forcefully even after a high court refused their application for an injunction. Then, there is 'manipulation' of the Mayor of Accra to provide drains for the residents of Glefe after threats of demonstrations and not voting for him and his party in the next general elections by residents of Glefe and Mpoase. Finally, through negotiations the Glefe Development Association was able to make Panbros Salt Manufacturing Limited commit to providing the community with skip pads and access roads to refuse collection sites.

Finally, there is a standoff between the community (Glefe) represented by the Glefe Community Development Association and the officials of Panbros Salt Mining Manufacturing Limited on the issue of re-engineering the Gyatakpo estuary and the embankment to minimise flooding in Glefe and its environs. This standoff is grounded in differences in knowledge on the causes of flooding in Glefe and its environs enforced by everyday life experiences of the residents and the pursuit of the organisational goals by Panbros Salt Manufacturing Limited. This represents a classic case of 'multiple realities of actors' (Long 1999, 2004).

6.6 Conclusion

In sum, this chapter has shown that legal pluralism exists within the regulatory framework for flood adaptation in Accra. Other challenges are lack of trust between the poor urban communities and the metropolitan assembly and static organisational culture in the formal organisations involved in drainage improvement in Accra. Formal flood management structures in Accra do not lend themselves to social learning and co-operative governance. These findings bear striking resemblance to the results of other studies from South Africa and Norway (Fatti and Patel, 2013; Koch et al. 2007; Naess et al. 2005).

The capitalist modernist approach to disaster management dominates flood management in Accra. This is because of the huge infrastructure deficit and the acceptability of structural measures among engineers and political elites at metropolitan and national levels, as well as residents of flood prone communities in Accra. These large-scale engineering projects enhance neo-patrimonial governance arrangements to the benefit of political elite and technocrats while bringing short-term relief to residents of flood prone areas.

Faisal et al. (1999) and Harries and Rowsell-Penning (2011) report a similar situation in Dhaka City, Bangladesh and United Kingdom respectively. Harries and Rowsell-Penning (2011) further explain that the dominance of structural measures in public flood adaptation in the United Kingdom was because of institutional culture and victim preference for engineering solutions. These findings, however, contrast earlier works by Penning-Rowsell et al. (2006) and Tol et al. (2003) which sought to give an indication that flood abatement policy in the United Kingdom and Holland were drifting towards a portfolio of structural and non-structural measures.

Communities engage metropolitan authorities and corporate entities for flood adaptation measures through community based organisations. Local knowledge on the causes of flooding influences their flood adaptation actions. Their local knowledge are derived from everyday life encounters and information obtained through interaction with technocrats at the metropolitan level and their own appreciation of the causes of flooding based on local occurrences.

The emergence of community based organisations in Accra involved in the struggle for urban services and infrastructure in Accra, their activities as well as challenges they face have also been documented by Gough and Yankson (2001) and Benneh et al. (1994). Similarly, Wekwete (1992) notes that in Southern Africa, “the urban poor are now predominant and in most cases are transforming the city to meet their needs, often in conflict with official laws and plans.”

CHAPTER SEVEN

THE CORRELATES OF HOUSEHOLD FLOOD ADAPTATION CHOICES AND RISK IN POOR COMMUNITIES IN ACCRA

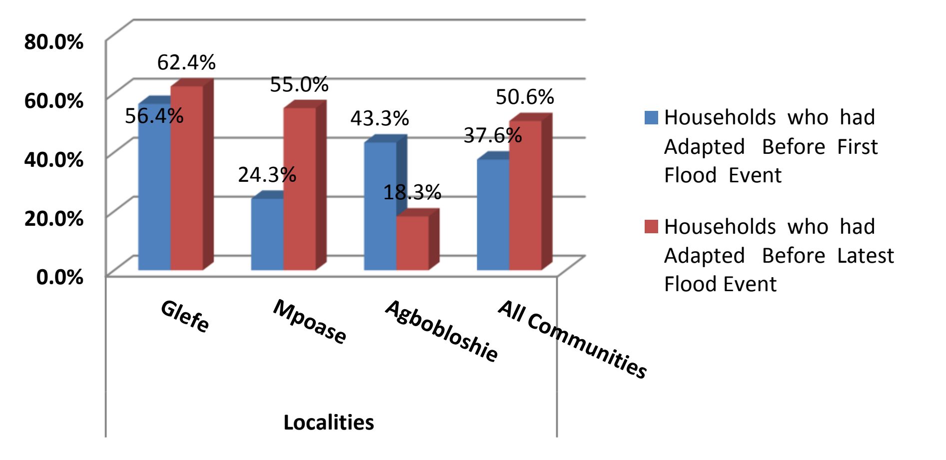
7.1 Introduction

Adaptation measures are carried out at various spatial scales. This chapter explores adaptation measures at the household level for their determinants and ability to minimise flood risk. Initially, the analyses draw on the concepts of adaptation and risk appraisal embedded in the protection motivation theory (Rodgers, 1983) and objective adaptive capacity (Grothmann and Patt, 2005) to explain household adaptation choices using logistic regression. Finally, this chapter investigates the link between household adaptation, socio-economic and geo-physical conditions on one side and household flood risk using ordered probit regression.

7.2 Types of Adaptation Measures at the Household Level

Some households in the study communities undertake adaptation measures to protect their homes from flooding whereas others do not. Generally, an estimated 37.6% of the 330 household surveyed undertook adaptation measures prior to their first household flood experience. The inter-community distributions are 56.4%, 24.3%, 44.3% for Glefe, Mpoase, and Agbogbloshie respectively. The proportion of adapters in the three study communities had increased to 50.6% by the latest flood event with 62.4%, 55% and 18.3% of the households surveyed in Glefe, Mpoase and Agbogbloshie respectively putting in precautionary measures at home ahead of the latest flood event prior to the study (see Figure 7.1).

Figure 7.1: Proportion of Households Who had Implemented Precautionary Measures prior to First and Latest Flood Events



Source Author's Field Survey, January 2014

Whereas the increase in the proportion of households who had taken precautionary actions between the two flood events was statistically significant at 5% ($\chi2$=3.733; p=0.034), the differences between adapters and laggards across the study localities were statistically significant at 1% for both first (χ^2=27.638; p=0.000) and latest flood events (χ^2=31.921; p=0.000). The types of adaptation measures undertaken by the households surveyed are presented in Figure 7.2 and Table 7.1.

Table 7.1 Household Flood Adaptation Measures Implemented Prior to Latest Flood Event

Flood Proofing Measures	Locality Names						All Communities	
	Glefe		Mpoase		Agbogbloshie			
	No.	%	No.	%	No.	%	No.	%
Filling and Cementing the Compound	38	37.6	73	43.2	4	6.7	115	34.8
Sand bags to form protective barriers	37	36.6	8	4.7	3	5.0	48	14.5
Raised Building foundation and Kiosk	16	15.8	14	8.3	1	1.7	31	9.4
Raised Door Step	22	21.8	30	17.8	5	8.3	57	17.3
Strengthen Door, Window and Roof	7	6.9	12	7.1	0	0.0	19	5.8
Construct Retaining Wall	21	20.8	20	11.8	1	1.7	42	12.7
Cement the Compound	8	11.6	3	3.1	0	0.0	11	3.3
Construct Earth and concrete Drains	13	12.9	27	16.0	4	6.7	44	13.3

Source Author's Field Survey, January 2014
Proportions represent households who undertook the adaptation measures specified

Prior to the latest flood event filling and cementing of compound (34.8%) was the most popular flood proofing measure among the adapters. Interestingly, none of the 330 households surveyed had taken up an insurance policy or had enrolled in a micro-finance scheme that they could fall on to aid recovery after floods. Plate 5.1 to 5.4 illustrates some of the household flood adaptation measures implemented in the three study communities.

Plate 7.1: Earth Drain –Mpoase

Plate 7.2 Toilet with a Raised Foundation-Glefe

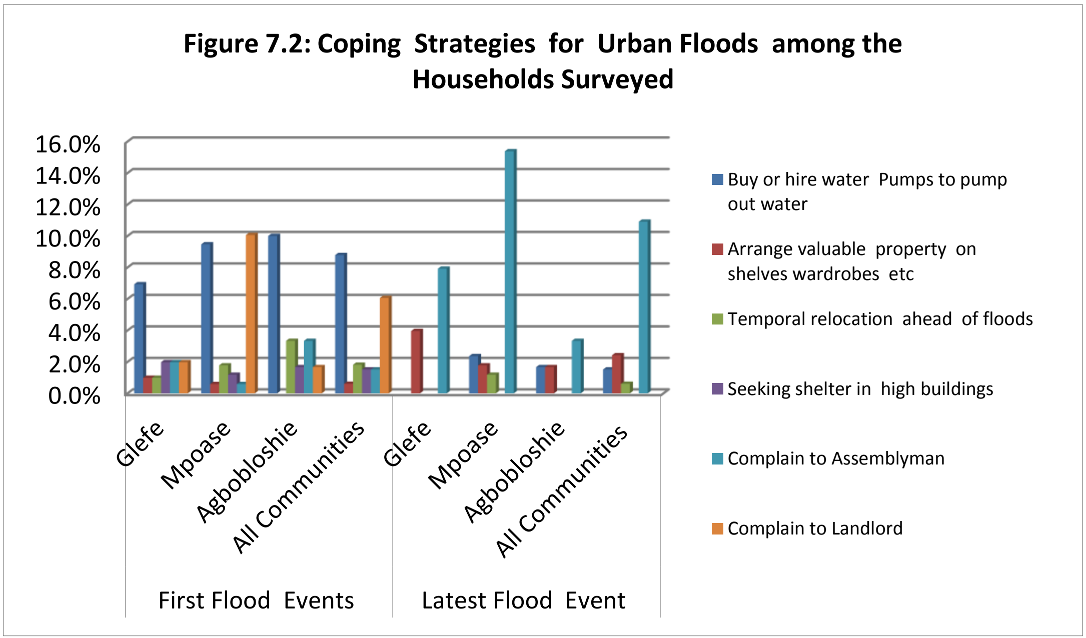
Plate 7.3: Raised Door Step-Mpoase

Plate 7.4: Building with a Retaining Wall-Glefe

Source: Author's Field Survey June 2014

Table 7.1 is indicative of household preference for flood evasion measures as compared to resisting, drawback and securing measures. Among the flood evasion measures, elevated configurations, in the form of filling and cementing the compound, raising building foundation were more prevalent than shielding homes with water barriers like retaining walls and sandbags.

Other measures mentioned by households during the survey are short-term coping strategies (see Figure 7.2). They include hiring mechanised pumps to pump storm water out of the compound and temporal relocation ahead of the rains. Political engagement for flood alleviation at the household level takes the form of making complains to the assembly members (Elected councillors) and/or landlords/ladies.



Source Author's Survey, January 2014

Comparing Table 7.1 and Figure 7.2, the preference is for households to undertake structural measures compared to non-structural measures. For example, 10.9% of the households surveyed complained to their respective assembly member about the flooding problem as against 34.8% who had filled their compounds prior to the latest flood event. In addition, political engagement for flood proofing at the household level is not popular among the households surveyed as less than 15% of households surveyed had ever consulted their landlord/lady or elected councillor (Assemblyman) on possible remedies to the flooding problem before each of the two events. This may be due to the fact that generally households did not believe that these avenues could resolve the problem at least in the short term.

The household flood adaptation measures found in the study communities have also been chronicled in several studies across Africa (Campion and Venzke, 2013; Sakijege et al. 2012; ILGS and IWMS, 2011; Adelekan, 2010; Jabeen et al. 2010; Aboagye, 2008; Douglas et al. 2008; Nchito, 2007; Atuguba and Amuzu, 2003). None of the households' surveyed practiced flood insurance although Aboagye (2012b) indicated in his study of Alajo in Accra that 5% of the sampled households had taken up some form of insurance ahead of the 2007 floods in Accra. There are very few micro-finance schemes in the study communities but their scope does not include packages for flood victims.

7.3 The Correlates of Household Adaptation Choices

The adaptation choices at the household level are the product of the interaction between household socio-economic conditions and cognitive processes (Grothmann and Pratt, 2005). In order to investigate the correlates of adaptation choices at the micro-level, the adaptation measures in Table 7.1 were reclassified into two groups namely permanent concrete works (AdaptCont) and minor remedial works (AdaptSoft). The permanent concrete works consist of filling and paving (cementing) compounds, raising the foundations of buildings and kiosks as well as erecting retaining walls. Generally, such measures are permanent, capital intensive and they require time and minimum knowledge of masonry to be effective.

Strengthening doors, windows and roofs lifting up kiosks (by placing them on cement blocks), raising doorsteps and constructing earth and concrete drains by households make up the minor remedial measures. Compared to permanent concrete works, these measures are low cost, less time consuming and require little knowledge of masonry. From the survey, 42.7% and 37.6% of the household surveyed lived in homes with permanent concrete works and minor remedial measures prior to the latest flood events respectively. More importantly, 49.4% lived in homes without any precautionary measures ahead of the latest flood event. The latest flood event occurred on 9th December 2013. Tables 7.2 and 7.3 present the cognitive and socio-economic variables that are associated with household adaptation choices among the households surveyed.

Table 7.2: Descriptive Cognitive Variables and Household Adaptation Choices

Variables	Household Adaptation Choices Implemented Prior to Latest Flood Event (%)		
	Minor Remedial Works	Permanent Concrete Work	No Precautionary Measure
	N=124	N=141	N=169
Perceived Occurrence of Floods (Next ten years against now)			
More	36.2 (*51*)***	43.1(*55*)*	50.7(*71*)*
Same	67.6(*25*)	56.6.(*24*)	29.7(*11*)
Less	31.0(*22*)	42.9(*30*)	49.3(*35*)
Did not Know	32.1(*26*)	38.6(*32*)	56.8(*46*)
Perceived Severity of Floods (Next ten years against now)			
More	39.8(*57*)**	43.4 (*62*)	47.9(*68*)
Same	60.0(*15*)	56.0.(*14*)	36.0(*9*)
Less	35.8(*25*)	42.9(*30*)	47.1(*33*)
Did not Know	29.3(*27*)	38.0(*35*)	57.6(*53*)
Availability of family and friends as Labour			
Yes	72.0(*64*)***	72(*74*)***	20.4(*144*)***
No	31.2(*60*)	31.2(*67*)	53.5(*19*)
Perceived Adaptation cost			
Moderate	49.1(*97*)*	60.0(*108*)**	29.1(*147*)***
Otherwise	35.3(*27*)	39.3(*33*)	53.5(*16*)
Adaptation Efficacy (Believe in Adaptation Measures)			
Yes	54.4(*75*)**	55.6(*91*)**	32.2(*134*)**
No	31.2(*49*)	37.9(*50*)	55.8(*29*)

Source: Author's Survey, January- 2014
Frequencies are in the parenthesis
Proportions represent households in the independent variable categories who undertook the choices specified
*****= p<0.01=1% level of significance, ** P<0.05 =5% level of significance, * = p<0.1=10% level of significance**

From Table 7.2 most of the psychological variables showed a statistically significant association with the household adaptation choices. For example, 36.5% and 67.6% of the households surveyed who perceive that the frequency of future flood occurrence (in the next ten years) will be more and the same as current situation respectively undertook at least one minor remedial measure prior to the last flood event. This is against 32.1% who perceived it was going to be less in future and 37.6%, who had no idea about future flood occurrence but adapted prior to the latest flood event ahead of the survey. The observed differences in the proportions were statistically significant at 1% ($\chi^2 =$16.658; p=0.001). This indicates that the association between perception on the future frequency of floods and undertaking minor precautionary measures like constructing earth drains prior to the latest flood event could not be due to chance.

Notably in Table 7.2 the relationship between household perception of future severity of floods and the implementation of permanent concrete works as well as no adaptation to urban floods were not statistically significant. This implies that whatever inference one draws from these differences in proportions is superficial.

Another set of exploratory variables for flood adaptation were socio-economic in nature. They include household wealth and tenancy status. Others are locality, length of stay in the community, household experience of property damage and presence of public concrete drain in front of the home. Grothmann and Pratt (2005) refers to these variables as objective adaptive capacity indicator variables in the Model for Private Proactive Adaptation to Climate Change (MPPACC) in that they can be easily verified and measured (see Table 7.3).

Table 7.3: Descriptive Socio-economic and Household Adaptation Choices

Variables	Household Adaptation Choices Implemented Prior to Latest Flood Event (%)		
	Undertook Minor Remedial Works	Undertook Concrete Works	Did Not Undertake Any Precautionary Measure
	N=124	N=141	N=163
Wealth Groupings			
Lowest Quintile	37.9(*25*)	34.8(*23*)*	51.5(*34*)**
Second Quintile	34.8(*23*)	43.9(*29*)	53.0(*35*)
Third Quintile	26.9(*21*)	33.3(*26*)	61.0(*48*)
Four Quintile	44.4(*24*)	46.3(*25*)	44.3(*24*)
Highest Quintile	47.0(*31*)	56.1(*38*)	33.3(*22*)
Length of Stay (in years)			
Less than < 5	28.9(*24*)**	28.9(*24*)*	66.3(*55*)***
Equal to/Greater than 5	40.5(*100*)	47.4(*117*)	43.7(*108*)
Sex of Head of Household			
Male	35.0(*73*)	43.0(*84*)	51.2(*105*)
Female	41.4(*51*)	45.3(*57*)	46.4(*58*)
Marital Status			
Single	40.6(*13*)	43.8(*14*)**	46.9(*15*)*
Married	42.1(*91*)	46.3(*100*)	45.8(*99*)
Others	24.4(*20*)	32.9(*27*)	46.9(*49*)
Educational Attainment of Household Head			
Up to Basic level	37.1 (*78*)	42.9(*90*)	49.5(*104*)
Secondary and above	38.3(*46*)	42.5(*51*)	49.2(*59*)
Property Damage			
More than once	40.5(*32*)	44.3(*34*)	49.4(*39*)
Once	32.8(*21*)	45.3(*29*)	48.4(*31*)
No Property Damage	38.0(*71*)	41.7(*78*)	49.7(*93*)
Tenancy Status			
Landlord	45.3(*76*)*	48.8(*82*)*	39.9(*67*)***
Relative of Landlord	26.8(*11*)	48.8(*20*)	48.8(*20*)
Tenant	30.3(*33*)	32.1(*35*)	62.4(*68*)
Percher	33.3(*2*)	33.3(*2*)	66.7(*4*)
Caretaker	33.3(*2*)	33.3(*2*)	66.7(*4*)
Locality			
Glefe	55.4(*56*)***	52.2(*53*)***	37.6(*38*)***
Mpoase	33.7(*57*)	49.7(*84*)	45.0(*76*)
Agbogbloshie	18.3(*11*)	6.7(*4*)	81.7(*49*)
All Communities	37.6(*124*)	42.7(*141*)	49.4(*163*)
Presence of Public Drain in front of Home			
Yes	39.0(*32*)	45.1(*37*)	43.9(*36*)
No	37.1(*92*)	41.9(*104*)	51.2(*127*)
Home Elevation			
Less than 10 metres	36.4 (8)	63.6(14)*	31.8(7)*
10 or More metres	37.7(116)	41.2(128)	50.6 (156)
Type of Wall Material			
Cement (sandcrete)	39.7(104)**	48.5(127)**	44.3(116)***
Others	29.4(20)	29.4(20)	69.1(47)

Source Author's Survey, January 2014
Frequencies are presented in the parenthesis
Proportions represent only households in the independent variable categories who undertook the choices specified
*****= p<0.01=1% level of significance, ** P<0.05 =5% (level of significance, * =p<0.1=10% level of significance**

Table 7.3 reveals that sex of head of household, property damage and presence of concrete drains in front of the home did not show any statistically significant association with any of the adaptation choices. In addition, wealth status did not show any statistically significant association with household implementation of minor remedial measures prior to the latest flood event.

Among the socio-economic variables, wealth groupings, length of stay in the community, tenancy status and locality of residence showed a statistically significant association with the selected adaptation choices among the households surveyed. From the survey, 28.9% of households who had stayed in their respective communities for less than five years implemented minor remedial measures compared to 40.5% who had stayed five years or more. The difference in this proportion is statistically significant at 10% (χ^2=3.546; p=0.06). Apart from this, 28.9% and 47.4% of the households surveyed who had lived in the study communities for less than five years and five or more years respectively undertook permanent concrete works ahead of the latest flood event.

Finally, 66.3% and 43.7% of the household surveyed who had lived in the community for less than five years and five years or more respectively had done nothing to protect themselves against flooding as at the last flood event before this study. The differences in these proportions were statistically significant at 1% (χ^2=8.644; p=0.003) for permanent concrete works and households who did nothing (χ^2=12.627; p=0.000). This suggests that the observed differences in proportions cannot be attributed to chance.

Table 7.2 and 7.3 show that whereas some of the cognitive variables and objective adaptive capacity indicators showed statistically significant associations with the selected household adaptation choices, others did not. Chi-square tests, however, do not give a good indication about strength and direction of the correlates of household adaptation choices. To achieve these, logistic regression models were used though test runs using multinomial logit also gave similar results.

Three models capturing the correlates of household adaptation choices in the study communities are presented in Table 7.4. These are household implementation of permanent concrete works (AdaptCont) and implementation of minor remedial measures (AdaptSoft). The final model presents the correlates of no adaptation, households who did not take any adaptation (precautionary) measures prior to the last flood event before the study (NoAdapt). The chi-square (χ^2) of the log likelihood is a measure of the overall significance of the model. All the three models were statistically significant at 1%, AdaptCont (χ^2= 94.27; p=0.000), AdaptSoft (χ^2 =103.67; p=0.000) and NoAdapt (χ^2=126.07 p=0.0000). This implies the three models are statistically significant.

The Hosmer Lemeshow chi-square (χ^2) test is a valid test for the goodness fit for logistic regression models. High levels of statistical significance of the Hosmer Lemeshow chi-square (χ^2) test connote better model fit. Hosmer and Lemeshow (1980) have suggested that statistical significance of 10% (p>0.05) and above represent a good model fit. The results for the three models, AdaptCont (χ^2= 3.04; p=0.9317), AdaptSoft (χ^2= 4.38; p=0.8217) and NoAdapt (χ^2= 10.80; p=0.2132) suggest a good fit. This is because test results were statistically insignificant ($p>0.1$) indicating that the models fit well with the data.

The overall percentage classified correctly is an estimate for the predictive power of the models. The reported values for all the three models are 73.64%. High proportion of correctly classified variables connotes better predictive power of models. The Pseudo-R^2 generated as part of the models are 0.2098, 0.2373 and 0.2756 for the three respective models. Unlike the R^2 in Ordinal Least Square (OLS) models, the Pseudo-R^2 in logistic regression are not able to determine accurately the proportion of the variance in the dependent variable explained by the variance in the independent variables. They cannot also be used for comparative purposes across models but they can be used to compare different specifications of the same model. The results presented in Table 7.4 fits the regression data to household choice of the three adaptation choices.

Table 7.4: Results of Logistic Regression of Household Flood Adaptation Choices and Socio-Psychological Variables

Variables	Household Implementation of Permanent Concrete Works (AdaptCont =1; Otherwise =0)					Household Implementation of Minor Remedial Measures (AdaptSoft=1 Otherwise =0)					Household who had not taken any Precautionary Measures - No Adaptation (NoAdapt=1 Otherwise=0)				
	Coef.	**S.E**	**Z**	**P>IzI**	**Exp (B)**	**Coef.**	**S.E**	**Z**	**P>IzI**	**Exp (B)**	**Coef.**	**S.E**	**z**	**P>IzI**	**Exp (B)**
HHSex (Ref. =Male)	0.4439	0.4498	1.54	0.124	1.5588	0.7135	0.6229	2.34	0.019	**2.0411****	-0.7086	0.1497	-2.33	0.02	**0.4923****
Tensh (Ref. =Landlord)															
Relative of Landlord	-2.100	0.3549	-0.48	0.631	0.8106	-1.5906	0.1006	-3.22	0.001	**0.2038*****	0.8292	1.0692	1.78	0.076	**2.2913***
Tenant	-0.375	0.2395	-1.08	0.282	0.6873	-0.7201	0.176	-1.99	0.047	**0.4867****	0.8436	0.8323	2.36	0.018	**2.3247****
Others	-0.1111	0.4862	0.02	0.838	0.8949	-0.4151	0.3993	-0.69	0.492	0.6603	0.8646	1.3639	1.5	0.133	2.3734
Mast (Ref.=Never Married)															
Married	-0.1184	0.4559	-0.1	0.921	0.9534	0.1680	0.5808	0.34	0.723	1.1829	0.1748	0.5981	0.35	0.728	1.191
Others	0.7042	0.4905	-0.2	0.839	0.8946	-0.7563	0.2643	-0.13	0.179	0.4693	0.4372	0.8686	0.78	0.436	1.5484
Educat (Ref. = Basic Education)	-0.1186	0.2655	-0.4	0.691	0.8881	0.2125	0.387	0.68	0.497	1.2368	-0.035	0.3026	-0.11	0.911	0.9656
CLenst (Ref= < 5 years)	0.7042	0.7022	2.03	0.043	**2.0222****	0.1776	0.4301	0.49	0.622	1.1943	-0.7897	0.1615	-2.22	0.026	**0.4540****
WStatus (Ref.=Lowest Quintile)															
Second Quintile	0.1849	0.5262	0.42	0.672	1.2031	-0.5501	0.2599	-1.22	0.222	0.5769	0.4228	0.6803	0.95	0.343	1.5262
Third Quintile	-0.3000	0.3281	-0.68	0.498	0.7408	-0.9685	0.1746	-2.11	0.035	**0.3796****	0.8309	1.0326	1.85	**0.065**	**2.2953****
Fourth Quintile	0.2307	0.6058	0.48	0.631	1.2595	-0.1267	0.4363	-0.26	0.798	0.8809	0.1218	0.5613	0.25	0.806	1.1296
Fifth Quintile	0.5445	0.7827	1.2	0.23	1.7237	0.1588	0.543	0.34	0.732	1.172	-0.4196	0.3068	-0.9	0.369	0.6573
PDrain (Ref. =Yes)	0.2701	0.4272	0.83	0.408	1.31	0.3429	0.4681	1.03	0.302	1.409	-0.5527	0.1982	-1.6	0.109	0.5754
DWallMat (Ref. Wood)	1.2126	1.3708	2.97	0.003	**3.3623*****	0.3790	0.3789	-0.09	0.924	0.9634	-0.8797	0.1645	-2.22	0.026	**0.4149****
Elevat (Ref.=< 10 metres)	-0.3052	0.2091	-1.08	0.282	0.7369	-0.2314	0.2314	-0.83	0.409	0.7835	0.5586	0.5167	1.89	0.059	**1.7482***
Pfoc (Ref. =More)															
Same	1.096	1.717	1.91	0.056	**2.9922****	1.4619	2.5707	2.45	0.014	4.314	-0.8816	0.2522	-1.45	0.148	0.4141
Less	0.3716	0.7706	0.7	0.484	1.4501	-0.508	0.3553	-0.86	0.390	0.6017	0.0519	0.587	0.09	0.926	1.0532
Do not Know	0.1244	0.5408	0.26	0.795	1.1324	0.2528	0.6470	0.5	0.615	1.2874	0.0953	0.5327	0.2	0.844	1.1001
Pfsev (Ref. =More)															
Same	-0.3928	0.4682	-0.57	0.571	0.6752	-0.3139	0.5195	-0.44	0.659	0.7306	0.2167	0.9121	0.30	0.768	1.242

Less	-0.2221	0.4309	-0.041	0.68	0.8008	0.2292	0.7307	0.39	0.693	1.2576	-0.2090	0.4548	-0.37	0.709	0.8114
Do not Know	-0.4009	0.3077	-0.087	0.383	0.6697	-0.5305	0.2868	-1.09	0.276	0.5883	0.2798	0.6172	0.6	0.549	1.323
Papcost (Ref. = Not Expensive)	0.7555	0.7593	2.12	0.034	**2.1287****	0.7274	0.7590	1.98	0.047	**2.0696****	-1.1615	0.1223	-2.97	0.003	**0.3130*****
Afflab (Ref. =Yes)	1.7595	1.7967	5.690	0.000	**5.8094*****	1.6532	1.6282	5.3	0.000	**5.224*****	-2.0231	0.0466	-5.71	0.000	**0.1322*****
Adeff i (Ref. = Yes)	0.4351	0.4795	1.400	0.161	1.5452	1.15	1.0215	3.61	0.000	**3.183*****	-1.0848	0.1125	-3.26	0.001	**0.338*****
ProDam (Ref=No Property Damage)															
Property Damage =1	-0.096	0.3652	-0.024	0.811	0.9084	-0.4967	0.258	-1.17	0.241	0.6085	0.2433	0.5418	0.57	0.567	1.2755
Property Damage= >1	-0.1938	0.2753	-0.058	0.562	0.8238	-0.0266	0.3338	-0.08	0.938	0.9737	0.06263	0.3735	0.18	0.858	1.0646

*****= p<0.01=1% level of significance, ** P<0.05 =5% level of significance, * =p<0.1=10% level of significance**

Model Diagnostics

AdaptCont		**AdaptSoft**		**NoAdapt**	
Log likelihood	-177.48821	Log likelihood	-166. 87712	Log likelihood	-126.68101
Number of Observations	330	Number of Observations	330	Number of observations	330
Chi square	94.27	Chi square	103.67	Chi square	126.07
Prob>chi square	0.000	Prob>chi square	0.000	Prob>chi square	0.000
Pseudo R^2	0.2098	Pseudo R^2	0.2373	Pseudo R^2	0.2756

A cursory look at Table 7.4 reveals that sex of head of household (HHSex) predicted household choice of minor remedial measures and no adaptation. Compared to their male counterparts' female heads of households were 2.04 times more likely to be in homes that had implemented minor remedial works as precautionary measures prior to the latest flood event. This observation was statistically significant at 5% for the minor remedial works (AdaptSoft). Female-headed households were also about 2.03 times less likely to be in homes where no precautionary measures against floods were undertaken prior to the latest flood event before the study. This observation was statistically significant at 10%.

Aboagye (2012a) argues that in Accra females have less access to resources for adaptation compared to males. Nonetheless, women normally seek to maximise security and safety, therefore they are more willing to invest in the safety of their home compared to men. All things being equal, women as landladies or renters are likely to invest in flood adaptation measures or will be willing to pay more as rent for accommodation with flood proofing devices compared to their male counterparts. This notwithstanding, most females are not resourced enough to either implement permanent concrete works as landladies, rent houses with permanent concrete works, or undertake these measures because of the cost involved and/or the fact that they will not be allowed by their landlords/ladies to undertake these flood proofing measures.

Compared to landlords/ladies all the other tenancy groups (Tensh) are more likely to be among households who opted to 'do nothing' ahead of the latest flood event. Table 7.4 is indicative of the fact that with reference to landlords/ladies, tenants were 2.3 times more likely to be among the households who had not adapted ahead of the latest flood event. In addition, renters were 2.3 times less likely to have implemented minor remedial measures prior to the latest flood event. Both observations were statistically significant at 5%.

The negative correlation between tenants and private proactive adaptation choices in the study communities can be explained in two ways. Primarily, power relations at sub community level are personified in tenant-landlord relations. As part of the tenancy agreements in the informal sector, tenants must seek the consent of landlords before any housing maintenance or home improvement works are undertaken. The two parties must agree on the type and extent of civil works as well as the mode of payment and work schedule before the tenant can go ahead with the works. This arrangement acts a disincentive for adaptive behaviour because the negotiations are sometimes lengthy and consensus is hardly achieved. There are also instances where tenants have been evicted because they complained about defects on housing. More importantly, renters in these communities are not guaranteed security of tenure hence investing in flood proofing measures is unattractive.

These social barriers act within the framework of a lower income elasticity for home improvement among tenants, especially migrants (Burns and Grebbler, 1977). Tenants, especially if they are migrants as in the case of the study localities, are pre-occupied with their survival, remittances to their places of origin or/and accumulating resources to finance their own housing projects. Hence, renters in the study communities are less likely to invest or contribute to private flood adaptation measures.

Relatives of homeowners were 2.29 times more likely to be among the households who had not adapted and 4.9 times less likely to be among those who have implemented minor remedial measures as at latest flood event prior to the study compared to home owners. These observations were at a statistically significant level of 1% and 10% respectively. Within the study localities, the presence of relatives of a landlord/lady in a house suggests family housing. Family housing as a form of social housing provides a social safety net for poor urban households in Accra (Mills-Tetteh and Adi-Darko, 2002). This is because it virtually eliminates out of pocket payments on housing rent. This savings should have provided additional resources some of which could have been channelled into adaptation to urban floods. However, living in family housing can be a disincentive for private adaptation to floods in the study communities.

Residing in a family house is sometimes characterised by petty quarrels and intra family conflicts, which generate inertia towards home improvement and housing maintenance including the most fundamental flood proofing measures. Apart from this, ambiguous home ownership regimes pervasive in family houses due to multiple claims of ownership leads to uncertainty and complexity in the home ownership structure. Under these conditions flood proofing housing is not attractive to the feuding factions, hence the negative co-efficient between relatives of landlords/ladies and proactive adaptation actions against floods at the household level.

Households who have lived in their homes for five years or more (CLenst) were 2.02 times more likely to be found in homes with permanent concrete works (AdaptCont) and 2.2 times less likely to be among the laggards (NoAdapt) compared to those who stayed less than five years. The observation for both permanent concrete works (AdaptCont) and no adaptation (NoAdapt) were statistically significant at 5%. Long-term migrants have more knowledge about adaptation options compared to new migrants. As households stay in one place for a long time, security of tenure and social networking improves and hence the likelihood that they will invest in some form of flood adaptation improves. Longer stay may also be associated with home ownership, which generally engenders adaptive behaviour.

From Table 7.4 households in the third wealth quintile (WStatus) were 2.3 times more likely to be among the laggards compared to those in the lowest quintile. Similarly, such households were 2.6 times less likely to be among households who had implemented minor remedial measures (AdaptSoft). The observation for the no adapters (NoAdapt) was statistically at 5% while that of minor remedial measures (AdaptSoft) was statistically significant at 10%. Generally, the wealth variables did not produce a linear relationship with the adaptation choices.

The type of building material (DWallMat) showed a positive relationship with the permanent concrete works and minor remedial actions. From Table 7.4 households living in sandcrete (cement) buildings were 3.3 times more likely to have undertaken permanent concrete works as flood adaptation measures within the home compared to households living in wooden and other sub-standard structures. However, compared to households found in wooden structures and the like, households living in sandcrete (cement) houses were 2.4 less likely to be among the no adapters. Whereas the correlation between type of household wall material and the implementation of permanent concrete works (AdaptCont) was statistically significant at 1% that of no adaptation (NoAdapt) was statistically significant at 5%.

Generally, sandcrete houses are more resistant to flooding than other type of housing found in poor urban communities, notably wooden shacks. Therefore, the presence of a sandcrete building should have negatively correlated with adaptation and positively with no adaptation. Nonetheless, in the study communities the poorest of the poor live in wooden structures. These poor households do not have the resources for flood adaptation especially permanent concrete works.

Home elevation (Elevat) showed the expected sign for permanent concrete works (AdaptCont), minor remedial works (AdaptSoft) and no adaptation (NoAdapt). The no adaptation (NoAdapt) co-efficient was statistically significant at 10%. This implies that among the households surveyed those living in homes at higher elevation (10 metres or more) were 1.7 times more likely to be among the no adapters ahead of the latest flood event compared to those living below 10 metre above mean sea level. Naturally, those who build on higher elevation or stay in storey buildings do not require additional precautionary measures to mitigate flooding.

With reference to households who perceive that more floods will occur in future (Pfoc), those who indicated that future flood occurrence will be the same as what pertain currently were 2.99 times more likely to undertake permanent concrete works (AdaptCont) like erecting a retaining wall to protect their homes from flooding. This observation was statistically significant at 10% (see Table 7.4). Households with a similar perception (same) were also 4.31 times more likely to implement minor remedial measures (AdaptSoft) like strengthening roofs, doors and windows ahead of the latest flood event at a statistically significance level of 5%.

The protection motivation theory speaks of perception about the occurrence of a threat as part of threat appraisal processes. When threat appraisal is positive it stimulates the protection motivation variable to engender adaptive behaviour. Flooding is a regular occurrence in the study communities and therefore perceiving that current situation will perpetuate itself into the future can imply a high threat appraisal. Since the comparison is between households who perceive that future occurrence of floods will be more and those who said it will be the same, the higher odd ratio for the ‘same group’ can mean that some of the households who perceive that the frequency of floods will be more in future may have resigned to their fate.

Another correlate of household adaptation to flood was perceived adaptation cost (Papcost) of implementing adaptation measures. In Table 7.4, households who perceived that the cost of implementing permanent concrete and minor remedial measures is moderate were 2.13 and 2.07 times more likely to be found in homes where permanent concrete flood adaptation and minor remedial measures had been implemented ahead of the latest flood prior to the study respectively. Such households were also 3.3 times less likely to be living in homes where precautionary measures against flooding were not taken ahead of the latest flood event prior to the survey. The observations were statistically significant at 5% for permanent concrete works (AdaptCont) and minor remedial measures (AdaptSoft) and 1% for no adaptation (NoAdapt).

Generally, the study population are among the poor in Accra who eke out their living from low earning informal and formal sector jobs. Under such harsh economic circumstances, sensitivity to small changes in the household budget is high. Hence perceived and real adaptation cost will play a major role in their adaptation decision-making process and choices especially as most adaptation measures are financed through household/personal resources.

A major predictor of private adaptation choices among the households surveyed is the presence of family hands and acquaintances to provide labour to support adaptation (Affalab). Table 7.4 shows that households with access to family and friends to support the implementation of flood proofing measures were 5.8 and 5.22 times more likely to be in homes where permanent concrete and minor remedial works were implemented prior to the latest flood event respectively, compared to households without this support. Apart from this, households with access to labour from family and friends were 7.56 times less likely to be found in homes where no precautionary measures were taken ahead of the latest flood event prior to the study.

The presence of family and friends is a form of bonding social capital. This reduces the cost of the adaptation measures. The presence of local masons, carpenters and other tradesmen within the family set up or as friends makes it easier to tap their expertise for the execution of civil and home maintenance works because as friends or family members these craftsmen are likely to charge sub market prices, work for free or be compensated in kind. Unskilled labour is also required in filling sandbags and carting fill material to the site where filling and paving are to be undertaken within the home. The availability of labour therefore engenders a certain self-help attitude among the households in the absence of public adaptation measures like public concrete drains.

Perceived adaptation efficacy (Adeffi) influenced adaptive behaviour positively and no/maladaptive behaviour negatively as suggested in the protection motivation theory and the model of private proactive adaptation to climate changes (MPPACC). Households who believed that the effects of flooding could be minimised through the pursuit of local flood proofing measures were 3.18 times more likely to be found in homes where minor remedial actions (AdaptSoft) had been implemented ahead of the latest flood events compared to those who thought otherwise at statistical significance level of 1%. Similarly, such households were 2.96 times less likely to be among the no adapters (NoAdapt) as at the latest flood event prior to the study. The inference from these statistics is that if poor people do not believe in the efficacy of an adaptation measure they will not be prepared to implement it with their meagre resources.

Other variables in the model, marital status (Mast), educational attainment of head of household (Educat), presence of a public concrete drain in front of a home (PDrain), perceived severity of future floods (Pfsev) and household experience of property damage from floods (ProDam) were not statistically significant. With the exception of marital status, all the other statistically insignificant variables met the a priori expectation.

The outcome of the following variables in the model, tenancy, perceived adaptation cost and adaptation efficiency, self-efficacy and perceived future occurrence of floods were consistent with that of Grothmann and Reusswig (2006). That of tenancy status was also similar to the finding of Kreibich et al. (2005). However, the finding on income (wealth) was not consistent with Grothmann and Reusswig (2006). Finally, Wolf et al. (2010) and Roy et al. (2012) emphasise the role of social capital in facilitating household recovery after floods. The results of this study point to the fact that the presence of social capital is also essential in private proactive adaptation among the poor in Accra.

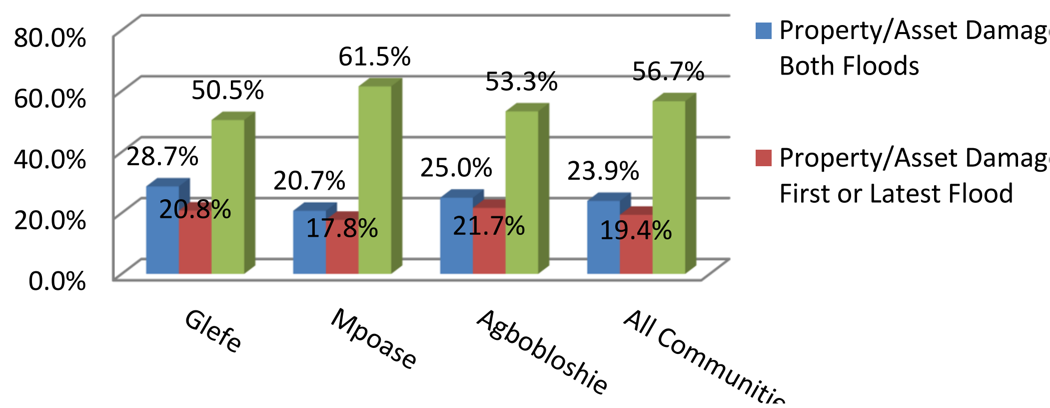
7.4 The Correlates of Household Flood Risk

Flood related damages/losses to household property/assets consists of damage to housing in the form of ripped roofs and/or collapsed buildings/walls as well as damage to household assets like refrigerators, television sets, radio sets and household furniture as well as stationery. There is also damage to business structures notably kiosks, sheds and metal containers, which accommodate home and neighbourhood based enterprises together with equipment and other inputs that are stored in these structures.

In order to analyse the determinants of household flood risk in the study localities, data on household first and latest flood experience were used. From the survey, household first flood experience dates back to 1978. Between that time and 2007, an estimated 52.6% of the households surveyed had experienced their first flood and by 2010, all the households had experienced their first flood event. The latest flood event in the study communities prior to the household survey occurred on 9th December 2013.

The frequency of reported flood damages were not evenly distributed across the study localities. In terms of the spatial distribution, households living in Glefe seem to have suffered more property/asset damage compared to those living in Agbogbloshie and Mpoase (see Figure 7.3).

Figure 7.3: Household Experience of Property/Asset Damage From First and Latest Flood Events (Cummulative)



Source: Author's survey, January 2014

From Figure 7.3 household report of damage to asset/property over the two flood events under consideration in Glefe were more than what pertains in the two other communities. During the household survey, 28.7% of the households in Glefe reported that they suffered damage or loss of property/asset in both the first and latest flood events compared to 20.7% and 25% in Mpoase and Agbogbloshie respectively. Apart from this, 20.8%, 17.8% and 21.7% of the households surveyed in Glefe, Mpoase and Agbogbloshie respectively reported of damage or loss of property/asset during either the first or latest flood event. Nonetheless, the differences across the study communities were not statistically significant ($\chi 2$=37.24; p=0.444).

Apart from the inter locality differences, socio-economic characteristics of households together with in-situ physical factors also associated with the level of household property/asset damage over the two flood events (see Table 7.5).

Table 7.5: Descriptive Variables and Property Damage Due to First and Latest Flood Event

Variables	Property/Asset Damage From First and Latest Flood Events (%)			Total
	Damage in Both Floods	Damage in One Flood Event	No Property Damage in Both Flood Events	
	N=78	N=64	N=188	
Wealth Groupings				
Lowest Quintile	25.8	19.7	54.5	100.0
Second Quintile	28.1	21.9	50.0	100.0
Third Quintile	23.5	18.5	58.0	100.0
Four Quintile	11.3	20.8	67.9	100.0
Highest Quintile	28.8	16.7	54.5	100.0
Sex of Head of Household				
Male	24.5	21.0	54.5	100.0
Female	25.0	16.4	58.6	100.0
Educational Attainment of Household Head				
No Education	32.6	20.9	46.5	100.0
Basic Education	21.6	20.4	58.1	100.0
Secondary	24.1	16.9	59.0	100.0
Tertiary	24.3	18.9	56.8	100.0
Tenancy Status*				
Home Owner	22.6	16.7	60.7	100.0
Others	25.3	22.2	52.5	100.0
Length of Stay in the Community				
Less than 5 years	18.1	18.1	63.9	100.0
5 years or More	25.9	19.8	54.3	100.0
Distance to Nearest water body (in metres)***				
Less than 60	54.8	11.3	41.9	100.0
60 metres or More	16.8	21.7	59.8	100.0
Elevation (in metres)**				
Less than 10	45.5	18.2	33.3	100.0
10 or More	22.4	19.5	61.9	100.0
Presence of Public Drain in front of Home				
Yes	23.2	23.2	53.7	100.0
No	24.2	18.1	57.7	100.0
Type of Wall Material**				
Cement/Sandcrete	20.6	20.2	59.2	100.0
Others	36.8	16.2	47.1	100.0
Household (persons)**				
1	16.7	16.7	66.7	100.0
2	19.4	13.9	67.7	100.0
3	23.7	16.9	59.3	100.0
4	18.6	14.3	67.1	100.0
5	13.3	22.0	64.4	100.0
6	29.3	34.1	36.6	100.0
7 or More	43.3	18.9	37.7	100.0
Precautionary Measures prior to Latest Flood Event**				
Yes	21.9	19.3	58.6	100.0
No	26.1	19.5	54.7	100.0

Source Author's Survey, January 2014
*****= p<0.01=1% level of significance, ** P<0.05 = (5% (level of significance), * =p<0.1=10% level of significance**

From Table 7.5 the following variables associated with reported property/asset damage after the occurrence of the two flood events in the study communities; tenancy, wall material, household size, distance to the nearest water body (river, lagoon and sea) and home elevation at mean sea level. The strength and direction of the associations observed in Table 7.5 are further explored using ordered probit regression analyses. The definition of each of the variables and the corresponding a priori expectation has already been presented in the methodology section (chapter four).

The results from the ordered probit model for the households surveyed in the three study communities are presented in Table 7.6. The log-likelihood is computed assuming all slopes are zero (restricted log likelihood) for the main model is -290.33011. The chi-square ($\chi 2$), for the main model is 67.60 is a valid test statistic for the hypothesis that the slopes on the non-constant regressors are zero. This is significant at 1% (p=0.000). The pseudo R^2 is 0.1043. The results of the regression analyses are presented in Table 7.6 together with three other scenarios, which are introduced to test the robustness of the main model across the three study communities. Scenarios 1, 2 and 3 represent dummies for Glefe (LocalG), Mpoase (LocalM) and Agbogbloshie (LocalA) respectively.

Table 7.6: Results of the Ordered Probit Regression Model of the Predictors of Household Experience of Property Damages Due to First and Latest Flood Events

Variables	Main (All Three Communities)				Scenario 1 (Glefe=1)				Scenario 2 (Mpoase=1)				Scenario 3 (Agbogbloshie =1)			
	Co-efficient	St. Error	Z	P>IzI	Co-efficient	St. Error	Z	P>IzI	Co-efficient	St. Error	Z	P>IzI	Co-efficient	St. Error	Z	P>IzI
HHSex	-.0515	.1447	-0.36	0.722	-.0530	.1457	-0.36	0.716	-.0566	.1461	-0.39	0.698	-.0535	.1449	-0.37	0.712
Ten	-.1156	.1555	-0.74	0.457	-.1128	.1589	-0.71	0.478	-.1094	.1094	-0.70	0.487	-.1193	.1561	-0.76	0.445
Educat	-.1255	.1517	-0.83	0.408	-.1267	.1524	-0.83	0.406	-.1289	.1523	-0.85	0.397	-.1253	.1518	-0.83	0.409
PDrain	.1207	.1607	0.75	0.453	.1172	.1658	0.71	0.480	.1172	.1613	0.73	0.467	.1333	.1662	0.80	0.423
DWallMat	**.6215*** **	.1823	3.41	0.001	**.6225*** **	.1827	3.41	0.001	**.6026*** **	.1961	3.07	0.002	**.5795** **	.2300	2.52	0.012
Elev	**.0496** **	.0223	2.22	0.026	**.0492** **	.0226	2.17	0.030	**.0491** **	.0224	2.20	0.028	**.0505** **	.0226	2.24	0.025
WDist	**.0027*** **	.0005	5.72	0.000	**.0027*** **	.0005	5.46	0.000	**.0027*** **	.0005	5.60	0.000	**.0027*** **	.0005	5.64	0.000
HoSize	**-.1091*** **	.0307	-3.55	0.000	**-.1091*** **	.0307	-3.55	0.000	**-.1100*** **	.0309	-3.56	0.000	**-.1107*** **	.0312	-3.54	0.000
Windex	.0037	.0752	0.05	0.961	-.0029	.0758	0.04	0.970	-.0010	-0773	-0.01	0.990	-.0006	.0765	-0.01	0.994
Lenst	-.0026	.0066	-0.40	0.689	-.0028	.0068	-0.41	0.683	-.0029	.0067	-0.43	0.669	-.0022	.0068	-0.33	0.745
DAdapt	**.3218** **	.1448	2.22	0.026	**.3230** **	.1455	2.22	0.026	**.3205**** **	.1449	2.21	0.027	**.3126*** **	.1481	2.11	0.035
LocalG					**.0149** **	.1707	0.09	0.930								
LocalM									-.0422	.1621	-0.26	0.795				
LocalA													-.0810	.2719	-0.30	0.766

*****= p<0.01=1% level of significance, ** P<0.05 = (5% (level of significance), * =p<0.1=10% level of significance**

Dependent variable is household property/asset damage due to first and latest flood events, ranging from household experience of property/assets damage in flood events (0), household experience of property/assets damage due to first, or latest flood event (1) to no household experience of property/asset damage from first and latest flood events (2)

Main Model
Number of Observations = 330
Log likelihood = 290.33011
Chi Square = 67.60
Prob>Chi-Square =0.000
Pseudo (R^2) = 0.1043

Scenario 1 (Glefe)
Number of Observations = 330
Log likelihood = 290.32629
Chi Square = 67.60
Prob>Chi-Square=0.000
Pseudo (R^2) = 0.1043

Scenario 2 (Mpoase)
Number of Observations = 330
Log likelihood = 290.2925
Chi Square = 67.66
Prob>Chi-Square=0.000
Pseudo (R^2) = 0.1044

Scenario 3 (Agbogbloshie)
Number of Observations = 330
Log likelihood = 290.28579
Chi Square = 67.69
Prob>Chi-Square =0.0000
Pseudo (R^2) = 0.1044

The models in Table 7.6 indicate that type of wall material (DWallMat), home elevation (Elev), distance to the nearest water body (WDist), taking precautionary measures ahead of floods (DAdapt) and household size (HoSize) are the significant predictors of household property/asset damage and loss. Of these, home elevation (Elev) and taking precautionary measures ahead of the latest flood event (DAdapt) were statistically significant at 5% but distance to water body (WDist), type of wall material (DWallMat) and household size (HoSize) were statistically significant at 1%. Elevation (Elev), distance to the nearest water body (WDist), adaptation prior to a flood event (DAdapt) and type of wall material (DWallMat) met the a priori expectation.

Sex of head of household (HHSex), tenancy status of the household (Tens), presence of a public concrete drain in front of the home (PDrain), length of stay in the community (Lenst), educational attainment of head of household (Educat) and wealth status of the household (Windex) were not statistically significant. The fact that presence of public drain was positive but not statistically significant is indicative of the fact that the presence of public lined drains in front of the home is not a sufficient condition for minimising property/asset damage from floods. While in general the study communities lacked engineered drains, the few available are either cracked or clogged with refuse impeding their ability to convey storm water and run off during floods.

Educational attainment, length of stay in the community and wealth status did not show the expected signs. The negative co-efficient for education (Educat) and wealth index (Windex) signal that higher formal education and wealth accumulation increase the probability of household incidence of flood related property/asset damages. This was against the a priori expectation. However, if households accumulate more assets in a flood prone community and did not move out or undertake any major flood adaptation measure then they have only succeeded in amassing wealth, which can be destroyed during flooding. As stated by Kreibich et al. (2005:117), "settling and accumulating values in inundation areas is always a risk, since absolute flood protection is impossible." Pelling (1999) in his study of political ecology of flood hazards in urban Guyana also confirms this position as he noted` that flood related damages were higher among high-income earners. However, a study of slum dwellers in Dhaka city by Braun and Aßheuer (2011), using flood water level and duration of storm/flood water within compounds as proxies of flood vulnerability, associated higher education and income with a decline in vulnerability to flooding. These revelations support Cannon (1994) in his view that asset holdings do not always correlate with some adverse impacts of floods.

For educational attainment, the reason for the negative sign may be that as household heads become more educated, they are likely to enter the formal labour market and improve the household financial profile. As household finances improve there is the likelihood of acquiring more assets (wealth), such as television sets and video decks, increasing the probability and magnitude of property/asset damage or loss after floods in the communities, all other things being equal. Furthermore, formal education does not guarantee knowledge about local site conditions and transactions in the informal land market in Accra. It is possible to misled highly educated people to acquire and develop housing in wetlands and other unauthorised areas exposing them to property/asset damage and other adverse consequences of flooding.

Although Table 7.6 presents the regression co-efficient, these are of little relevance in ordered probit analysis, as they do not provide any insight into the strength of the individual regressors (Greene, 1997). The marginal effects of the exploratory variables at their respective means provide this information as it measures small changes in the regressors on the outcome variable. This notwithstanding, in the case of a dummy variable the marginal effect represents a change of the dummy (0) to one (1) on the outcome variable. The marginal effects for both the main model and three scenarios are presented in Table 7.7.

Table 7.7: Marginal Effects of Significant Variables in the Ordered Probit Model for Household Property/Asset Damage due First and Latest Flood Events

Variables	Property/Asset Damage in Both Flood Events (Outcome =0)				Property Asset/ Damage in One Flood Event (Outcome = 1)				No Property /Asset Damage in both Floods (Outcome 2)			
	Main	Scenario 1	Scenario 2	Scenario 3	Main	Scenario 1	Scenario 2	Scenario 3	Main	Scenario 1	Scenario 2	Scenario 3
DWallMat	-.2006	-.2010	-.1939	-.1858	-.0433	-.0434	-.0429	-.0422	.2440	.2444	.2368	.2280
Elev	-.0141	-.0141	-.0140	-.0144	-.0053	-.0052	-.0052	-.0054	.0194	.0193	.0192	.0198
WDist	-.0008	-.0008	-.0008	-.0008	-.0003	-.0003	-.0003	-.0003	.0010	.0010	.0010	.0011
HoSize	.0311	.0311	.0314	.0316	.0116	.0116	.0117	.0118	-.0428	-.0428	-.0431	-.0434
DAdapt	-.0920	-.0924	-.0916	-.0893	-.0337	-.0016	-.0336	-.0328	.1257	.1262	.1252	.1221

In Table 7.7 the probability that a household reports of property/asset damage or loss in both or either the first or latest flood event decreases by 20% and 4.3% respectively as household wall material changes from wood and less resistant materials to cement/sandcrete. Those living in cement/sandcrete houses were also 24.4% more likely to encounter no property/asset damage or loss in both flood events. Cement/sandcrete is more resilient than wood, which formed the overwhelming majority of the other wall materials observed in the three study communities.

Living at a higher elevation positively associated with a reduction in flood related property/asset damages and losses. Table 7.7 is indicative of the fact that a unit increase in home elevation (Elev) induces a 1.4% and 0.5% decrease in the probability of household report of property/asset damage in both and one flood event respectively. It also induces a 1.9% increase in the probability of household reporting no property/asset damage in both flood events. These imply that in the generality of cases living in story buildings, raising foundation through filling and elevating kiosks and other temporal structures is a virtuous endeavour in these communities as these precautionary measures attenuate flood risks.

Elevating houses and other structures in the study communities can improve the height of structures above flood water level thereby preventing water from entering rooms to destroy property/assets. This observation may also explain why most households practise filling of the substructure before erecting their superstructure as an adaptation measure against flooding.

Distance to the nearest water body (WDist) predicted household report of property/asset damage due to floods among the households surveyed. A unit increase in the distance to the nearest water body reduced the probability of household report of property/asset damage in both floods and in one of the two flood events by 0.1%. In contrast, it improved the probability of household experience of no property/asset damage over the two events by 0.1%.

This implies that exposure to flood risk is accentuated by living close to the river/lagoon or sea. In Glefe and Mpoase housing development has encroached on the reservation of the Gbugbe and Gyatakpo lagoons. The receding coastline also exposes households living close to sea to storm surge and tidal wave attack causing property/asset damage.

These notwithstanding, household awareness about the risk involved in living close to the water bodies are relatively low among the household surveyed. In the study, three-quarters (75%) of the households surveyed revealed that they were not aware that theirs houses were within the flood zone as at the time they were settling in the study communities; the breakdown being 61.6%, 86.6% and 64.9% for Glefe, Mpoase and Agbogbloshie respectively. Every year during the dry season, Gbugbe and Gyatakpo lagoons shrink and land becomes available. These wetlands are quickly leased out to prospective developers for housing development. As the developers operate outside the formal land market and planning system, they develop these hazardous sites without consulting the planning authority for advice. Come the rainy season they realise that they are living in a flood zone but because of the huge investments that they have already sunk into their building projects they are reluctant to relocate.

Ignorance about site conditions alone did not explain the rising population and housing densities in these flood prone zones. One out of every four households surveyed (25%) indicated that they were aware of the fact that they were residing in a wetland at the time they were settling in the community. Those who indicated knowledge about the site conditions prior to settling in the study communities, alluded to the role of land affordability (24.7%) and low rents (39.9%) as well as the attraction of living in family housing (24.7%) as the three most important pull factors.

Other reasons like proximity to workplace and moving in to joining friends also accounted for 19.8% of the reasons why in spite of the knowledge of the challenging site conditions, households still opted to live in the study communities.

From Table 7.7 a unit increase in the household size increases the probability of household incidence of property/asset damage or loss in both floods by 3.1% and in one of the two flood events by 1.2%. Subsequently, it reduces the probability of no property/asset damage in both flood events by 4.3%. The effect of household size on property/asset damage is not very clear. The most logical explanation may be that as household sizes increase there is the possibility of acquiring additional assets hence increasing the risk of property/damage due to floods in the study communities. Apart from this, increase in household size may lead to the displacement of some in assets formerly kept indoors to be placed in porches and outside the house.

Finally, Table 7.7 shows that undertaking precautionary measures like filling and cementing the compound and constructing retaining walls around homes prior to the latest flood event reduced the incidence of property/asset damage from floods. The probability that households report of property damage/loss from both and one flood event reduced by 9.2% and 3.3% respectively between no adapters and adapters. Similarly, the probability that a household reports ‘no property damage/loss’ also increased by 12.5% with the implementation of an adaptation measure prior to the latest flood event before the study. This result emphasises the merit of household proactive adaptation in the study communities.

The positive effect of living in sandcrete housing and in homes at high elevation on flood risk reduction collaborates the findings of an earlier study on physical vulnerability of slum dwellers in Naga city to urban floods (Sagala, 2006). That of proximity to water bodies also confirms the findings of Yarnal (2007) in his study on household vulnerability during Hurricane Katrina in New Orleans. Similarly, Kreibich et al. (2005) also found out in their study of the 2002 Elber floods in Germany that taken proactive flood adaptation measures reduced the incidence of asset damages.

7.5 Conclusion

Households living poor communities in Accra improvise to protect their property/assets from the adverse impacts of flooding. Household flood adaptation measures mostly consisted of flood ‘evasive’ measures like filling and cementing the compound and erecting retaining walls. Less than 15% of the households surveyed engaged their respective assembly members (elected councils) and property owners for remedial measures to mitigate the problem of flooding.

The Protection Motivation Theory posits that adaptation choices are triggered by two psychological (cognitive) processes, risk appraisal and coping (adaptation) appraisal. In this study, adaptation appraisal variables namely perceived cost, perceived adaptation efficiency (believe that local adaptation measures can minimise flood related property damage or loss) (statistically) predicted household flood adaptation choices. Other correlates of household adaptation were perceived self-efficacy and presence of social capital, measured by the presence of friends/family hands to support household adaptation efforts. These are also adaptation appraisal variables. Perceived future occurrence of flood was the only perceived risk appraisal variable that significantly (statistically) predicted flood adaptation choices at the household level. Among the socio-economic and physical factors in the model, wall material, topography (home elevation), length of stay in the community, home elevation and tenancy showed a statistically significant correlation with adaptation choices at the household level.

The correlates of property/asset damage due to floods are home elevation, distance to the nearest water body, type of wall material and household size. These arise out of a situation of ignorance about local site conditions and the workings of the informal urban land market among the poor. Finally, household experience of property/asset did not positively influence adaptive behaviour but taking precautionary measures ahead of floods reduced flood related property/asset damages and losses among the poor in Accra. Cutter (1996) contextualises these factors in her concept of 'vulnerability of place'.

CHAPTER EIGHT

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

The concluding chapter presents emerging issues from the data analyses as well as the policy recommendations to improve public and private proactive adaptation to floods in Accra. Areas of further research are also presented as part of this chapter.

8.2 Summary of Findings

The study explored private and public adaptation to urban floods among the poor in Accra from an actor-oriented perspective. Specifically, the objectives were as follows:

i. to analyse the causes of flooding in poor urban communities in the Accra Metropolitan Area from various actor perspectives;

ii. to understand the role and challenges of actors involved in flood adaptation in the Accra Metropolitan Area; and

iii. to determine the correlates of household flood risk and private proactive adaptation choices among the poor in the Accra Metropolitan Area.

This study compared perceptions on the causes of flooding among the major actors involved in flood adaptation within the Accra metropolis. There was strong agreement (70.4% - 87.3%) on the perceived causes of flooding among the households surveyed across the three study communities. Agreement on the perceived causes of flooding declined considerably between the community leaders, households and the technocrats surveyed. The level of agreement on the perceived causes of flooding between technocrats at the metropolitan level and households in Glefe for example, was as low as 8.5%. Externalisation of blame and responsibilities for flood alleviation as well as actor interest explain the differences in perceptions on the causes of flooding between the different groups of actors surveyed. Similar household socio-economic characteristics and living conditions underpin the high level of agreement on the perceived causes of flooding reported across households in the study communities.

Power relations among actors involved in drainage improvement in Accra is characterised by powerful central government entities unwilling to devolve resources (power) to local government institutions on the ground and the strict pursuit of organizational goals by various actors. These situations hamper effective collaboration among actors. Legal pluralism was identified as a major challenge to zoning regulation for flood risk reduction, as it allows both the traditional landowners and officials of planning authority to appropriate the power to determine land use simultaneously. Mistrust between communities and the officials of the planning authority born out of negative encounters with each other was also identified as challenge in enforcing zoning regulations in flood prone low income communities in Accra.

The hazard centred approach to disaster management guides institutional response to flooding in Accra. Non-structural measures and local knowledge from community based organisations and other informal actors at the community level have very little relevance in this approach. This situation does not auger well for social learning in flood adaptation. In contrast, local knowledge and perceptions drive community level adaptation actions. Informal actors, notably Community Based Organisations like

Development and Landlords Associations champion these actions, which take for negotiations and contests with the Accra Metropolitan Assembly and its decentralised departments as well as corporate entities whose activities they perceive are the cause of flooding in their community.

The study estimates that 50.6% of the households had adapted prior to the latest flood event on 9th December 2013. In terms of the correlates of flood adaptation choices at the household level, female-headed households, tenants, those living at high elevation and in wooden structures together with new arrivals in the community were more likely to be among the no adapters. For example, with reference to homeowners, tenants were 2.32 times more likely to be found in homes without any flood proofing measure prior to latest flood before this study.

In line with the Protection Motivation Theory, perceived adaptation cost, perception that local adaptation measures can minimise flood related losses and the presence of family/friend labour showed a negative association with no adaptation while perceived future occurrence predicted only adaptation. For example, compared to those who perceived otherwise, households who perceive that local adaptation measures are moderate were 2.13 times more likely to be found in homes where precautionary measures like erecting retaining wall were had been undertaken prior to the latest flood event before the study. In addition, households who perceive that the local adaptation measures are moderate were 3.3 times less likely to be among the no adapters compared to households who indicated otherwise.

The study found out that home elevation, distance to the nearest water body, living in sandcrete housing and taking precaution measures ahead of flood events reduced flood risk in the study communities. Living in sandcrete buildings and undertaken precautionary measures improved the probability of a household report of no property damage or loss from the first and latest flood experience by 24.4% and 12.5% respectively. A unit increase in home elevation and distance to the nearest water body improved the probability of household report of no property/asset damage or loss by 1.9% and 0.1% respectively.

This notwithstanding, 18.8% of the houses surveyed were located within mandatory 60 metres reservation for water bodies (as stated in riparian buffer zones policy), while 54.2% lived in homes with an elevation lower than 10 metres above mean sea level. In addition, 22.1% did not live in sandcrete building of which the majority were wooden shacks. More importantly, 49.4% of the households surveyed had not taken any precautionary measures against flood as at the latest flood event prior to the study.

8.3 Policy Recommendations

One of the biggest challenges to institutional adaptation to urban floods in Accra is conflicting interpretation of to the concept of land use between formal and informal actors and different perceptions on the causes of flooding among various actors in flood adaptation. To resolve this problem requires a partial integration of informal institutions into the formal Assembly structure. This can begin with co-opting representatives of these institutions, notably traditional authority, development and landlords associations, into some committees of the Assembly that relate to flood zoning and risk management as ex-officio members. The advantage of such a policy is that the informal actors get the opportunity to bring their knowledge on the causes and adaptation measures against floods to bear on the discussions at the assembly level.

In addition, integrating informal actors in flood adaptation with the formal actors has the potential to reduce the level of mistrust as well as externalization of blame between the formal and informal actors on causes of flooding. Under such an arrangement, local actors acquaint themselves with flood abatement plans, programmes and projects of the Accra Metropolitan Assembly and are therefore in a better position to inform their constituents. Yeboah and Shaw (2011) propose education and then sanctioning of chiefs and tribal elites who engage in land transactions outside the formal planning system. For this recommendation to be effective, they must evolve from the collaborative effort of informal and formal actors in flood adaptation in Accra.

There is no doubt that large-scale engineering projects will dominate public adaptation to urban floods in Accra at least in the short to medium term. This is not problematic in view of the existing infrastructure deficit and the employment generating capacity of civil works. This notwithstanding, the lack of enthusiasm in perusing complementary non-structural flood adaptation measures in Accra is a problematic in that the pursuit of only structural measures so far has failed to reduce vulnerability to urban floods in the city. There should be a gradual but sustained effort to integrate structural and non-structural measures when dealing with flood alleviation in Accra. A good starting point is to introduce flood zoning and community based awareness creation components into the 660 million dollar Accra Sanitary Sewer and Storm Water Alleviation Project (Conti Project) planned for the city of Accra.

Vulnerability to floods among the households surveyed was occasioned by building close to water bodies at low elevations as well as living in wooden structures and substandard housing. The presence of semi-skilled labour also positively influenced household adaptation among the households surveyed. Dealing with these vulnerabilities at the community level as well as enhancing household adaptation to floods in poor urban communities will therefore require in-situ community upgrading. Community upgrading will reduce exposure to flood risk by providing the necessary infrastructure such as drains and refuse collection services in the poor urban communities. It will provide employment opportunities and income for households in these poor urban communities and stimulate private investments in home improvement some of which are flood-proofing measures.

If the upgrading schemes provide training in construction skills/methods then there will be skills transfer, which will increase the pool of semi-skilled artisans within the poor communities. The artisans can support adaptation efforts at community and household levels. The presence of the artisans will also reduce the perceived and actual cost of implementing household adaptation measures and increase self-efficacy among the household in these poor flood prone communities.

Another initiative for reducing exposure to floods is involuntary resettlement as suggested by Oteng-Ababio et al. (2011). While re-locating households living in hazardous zones is preferable, it comes with some adverse social and property impacts and costs that may make it difficult for the state to implement. Resettlement must also be well discussed and planned together with the affected households.

Finally, ignorance about local site conditions is a major cause of vulnerability to flooding among the households surveyed. Therefore, soil and vegetation characteristics and construction methods/materials in flood prone areas should form the thrust of any awareness creation campaign among the poor in Accra. Perception on future occurrence of floods also showed a positive effect on adaptation implying that awareness creation should also take cognisance of perceptions about future occurrence of floods.

8.4 Conclusion

Accra, like many African cities, has experienced an increase in the number of flood events in the past decade. The expectation is that due to climate change/variability more severe floods will occur in across Africa with greater uncertainty about their onset. Floods will adversely affect cities on the African continent. This calls for greater emphasises on proactive adaptation at all scales as well as co-operation from all actors involved in flood adaptation.

The contribution of this study in this context is that it has brought to the fore the role of actor perceptions in creating knowledge about the processes through which flood risks unfold in poor urban communities. Secondly, it has provided conceptual clarity on how perception, knowledge domains, power relations and human agency translate into flood adaptation actions/choices of actors in a typical African city. In so doing, the study has provided an alternative narrative that explains adaptation to urban floods in low-income urban communities in Africa.

8.5 Areas of Further Research

So far, the discussions on adaptation to flooding in the global south have centred on reducing flood risk as measured by property/asset damage or loss. Nonetheless, there are several other adverse consequences of flooding, notably productivity losses and health related impacts. Further research should consider documenting and possibly quantifying these effects of flooding on households as well as establishing the determinants of household preventive measures to minimise the impact of these other consequences on households. The integration of local knowledge into formal early warning systems to improve lead-time is also an area that can be explored further as formal early warning systems are weak in Accra and other cities in Africa. The low uptake of flood insurance packages is also worth investigating from both the demand and supply sides.

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Appendices

APPENDIX A

ADAPTATION TO URBAN FLOODS AMONG THE POOR IN THE ACCRA METROPOLITAN AREA IN A CHANGING CLIMATE

Household Questionnaire

A: Informed Consent Form

NOTE: To be administered to the HEAD of household or any ADULT knowledgeable member of the household

Hello, my name is **Emmanuel Anyang Abeka**. I am working on a student project that looks at household adaptation against urban floods. In Accra, the study is taking place in three selected communities namely Mpoase, Agbogbloshie and Glefe. In this community, a number of households have been selected to participate in this study and your household happens to be one of them. I would like to ask you some questions about your household. The questions are generally about the causes, perceptions and adaptation to floods. I will also ask a few questions about your household asset base and other socio-economic issues.

I would like to assure you that the information you provide would be kept strictly confidential. There is no way your identity will be revealed to anyone apart from the members of the research team. Your participation in this work is very important to help the study gather the relevant information to help to improve upon adaptation to floods in Accra.

You are free to participate in this study, which will take about 45 minutes of your time to complete. If you agree to participate in this study, there are questions you may skip if you are not comfortable with them. You can also discontinue the interview if need be at any stage.

You may also ask any question about this study if you so wish at this stage. Are you please willing to take part in this study based on the information I have provided you?

YES = 1, NO = 2 [ ]

Serial Number of Questionnaire:			

1. EA NUMBER*..

2. LOCALITY NAME...

3. TYPE OF SETTLEMENT (COASTAL = 1; INLAND = 2)..........................

4. NAME OF ENUMERATOR ………………………………………………………….

5. DATE OF INTERVIEW [DDMMYYYY] ....

6. NAME OF HEAD OF HOUSEHOLD..

7. NAME OF RESPONDENT (If not head)………………………………………………….

8. ADDRESS OF HOUSEHOLD.. ....

9. NAME OF AREA/NEIGHBOURHOOD …………………………………………………..

10. STATUS OF RESPONDENT IN HOUSEHOLD:

1. Head
2. Spouse
3. Other *(specify)*..

11. DISTANCE TO THE SEA (**IN MINUTES**)? ………………………………………………………….

12. DISTANCE TO THE INLAND WATERBODY (IN MINUTES)? ……………………………………………………

13. DISTANCE TO SEA (IN METRES BY GPS)? …………………………………………………………..

14. DISTANCE TO INLAND WATERBODY (IN METRES BY GPS) ……………………………………….

15. ELEVATION OF THE HOUSE (METRES ABOVE SEA LEVEL) ………………………………………….

A. Development Challenges

A1. Mention the **three (3)** most important development challenges in this community?

1. Crime
2. Poor drainage (lack of drains, choked drains
3. Haphazard housing development
4. Lack of roads
5. Education
6. Infectious Diseases (Malaria, diarrhoeal diseases, Skin Diseases)
7. Access to Potable Water
8. Sanitation
9. Flooding
10. Other (specify) ________________________________
11. Other (specify) ________________________________

1st [ ]

2nd [ ]

3rd [ ]

B. General Flood Experience

B1. How long has your household been staying in this community? _________ years

B2. Has the household experienced flooding **(water entering homes/compounds)** since you settled in this community?

1. Yes [ ] 2. No [ ]

B3. If yes **(to question to B2)**, how many times has your household experienced flooding since you settled in this community? _______ times

B4. Give the years that your household experienced floods (water entering your home and/or compound)?

a. ______________________________

b. ______________________________

c. ______________________________

B5. Of these can you recall the year that the most devastating floods occurred in this community? ____________

B6. What is the maximum (highest) time that flood water has stay in your home or compound? _________ days

B7. What is the least time that flood has stayed in your home or compound? __________ days

B8. How often do you experience floods (water entering rooms/homes/compound) last year? ___________

1. None [ ] 2. Once [ ] 3. Two times [ ] 4. Four Times [ ]
5. Five Times [ ] 6. More than Five Times [ ]

B9. In what year did you experience the **first flood event** (water entering rooms and compound) since you settled here? ______________

B10. In what year did you experience the **last /latest flood event (water entering rooms and compound)** since you settled here? _______________

B11. What are the **three (3) major causes** of floods in this community?

1. Act of God/gods
2. Location of the house close to the sea
3. Heavy rains
4. Haphazard Housing Development in the community
5. Poor drainage within the community
6. Drainage problems elsewhere
7. Natural occurrence which come and go
8. Sea waves attack
9. Housing development elsewhere
10. Sand winning/ceramic winning
11. Poor refuse management
12. Other (specify) ______________________
13. Other (specify)______________________
14. Other (specify) ______________________

1st [ ]

2nd [ ]

3rd [ ]

B12. Give reasons for the first choice answer **in question B11** above

a. ____

b. ____

B13. Were you aware that this area is liable to flood when you were about to settled here? 1. Yes [ ] 2. No [ ]

B14. If **yes to question B13,** why did you settle here despite the fact you knew the area was liable to flood?

1.Low Rent [ ] 2. Low Cost of Land [ ] 3. Born in this Community [ ]

4. Proximity to Workplace [ ] 5. Family Ties [ ]

6. Other (Specify) ____________________________

B15. If **no to question B13,** if **you knew this area was liable to flood** will you have settled here?

1. Yes [ ] 2. No [ ]

B16. Have you ever lost property or your property been damaged by floods?

1. Yes [ ] 2. No [ ]

B.17 Have you heard that floods have destroyed property and caused problems in this community before?

1. Yes [ ] 2. No [ ]

B18. Have you seen any household or households whose property has been destroyed by flood in the community?

1. Yes [ ] 2. No [ ]

B.19 Do you think that flooding **(water entering rooms and compounds)** can be minimised when household do certain things like constructing earth drains, retaining walls, placing sanding bags to protect the home etc?

1. Yes [ ] 2. No [ ]

B20. Do you have people (family and friends) who will readily assist you when you decide to undertake measures to protect the home from flooding?

1. Yes [ ] 2. No [ ]

B21. What do you think about the cost of implementing measures to protect your home from flooding?

1. Expensive [ ] 2. Moderate [ ]

C. <u>First Flood Experience</u>

C1. How long did it take you to experience your **first flood event** after settling in this community? ______ years

C2. Which year did your household experience the first flood in this community? ___________________

C3. Did you undertake any precautionary/preventive measure (s) before **the first flood event** you experienced in this community? **1. Yes [ ] 2. No [ ]**

If Yes in C3, Go to Question C7

If No in C3, Go to Question C4

C4. If **no in question C3,** why did your household not take any precautionary measure prior to the **first** flood event?

		1. Yes	2. No
i.	Did not know what to do/No one to turn to	[ ]	[ ]
ii.	No Money	[ ]	[ ]
iii.	Prevented by the landlord/lady	[ ]	[ ]
iv.	Thought floods will not be that severe	[ ]	[ ]
v.	I believe floods will not happened again	[ ]	[ ]
vi.	No protection is adequate against floods in the community	[ ]	[ ]
vii.	Other (Specify) ______________________________	[ ]	[ ]
viii.	Other (Specify) ______________________________	[ ]	[ ]
ix.	Other (Specify) ______________________________ `	[ ]	[ ]

C5. If **yes in question C**3, what factors did you consider prior to choosing the adaptation measure/measures?

	1. Yes	2. No
i. No/Cheaper Cost	[ ]	[ ]
ii. Able to use family and friends as support/labour	[ ]	[ ]
iii. Have family/friends living in other parts of the city	[ ]	[ ]
iv. We felt we could do it ourselves	[ ]	[ ]

v. Other (specify) ____

C6. If **yes to question C3**, how did you get to know about the selected adaptation strategy?

1. Family [ ] 2. Friends [ ] 3. Neighbours [ ] 4. Other (specify) ______________

C7. If **yes to question C3**, what did you do to protect your household (adaptation measure) before **the first flood event**?

	Adaptation Measures	1. Yes	2. No
i.	**Filling the Compound with sand/refuse**		
ii.	**Sandbags to form protective barriers**		
iii.	**Raised building foundation or level of the kiosk/containers**		
iv.	**Raised door steps**		
v.	**Strengthen of doors and windows**		
vi.	**Construction of Protective/Retaining walls**		
v.	**Temporal Relocation ahead of heavy rainfall**		
vi.	**Cementing the floor of the compound**		
vii.	**Construct Drains**		
viii.	**Buy or Hire water pump to pump water out of home**		
ix.	**Arrange valuable property on wardrobes and shelves/ etc.**		
x.	**Seek Shelter on roofs/ higher buildings in the community**		
Xi	**Insurance**		
Xiii	**Susu (that allows to take some money after floods)**		
Xiv	**Complain to the landlord**		
Xv	**Complain to Assemblyman**		
Xvi	**Other (Specify)**		

C8.. If **yes in question C7 (Structural Measures),** provide details on the cost of adaptation measures implemented?

Year _______________

a. Labour GHC ________________

b. Material (including transportation) GHC _______________

c. Other Cost GHC _______________

C9. If household mentioned **susu or insurance in question C**7, how much did the household pay per month? _________GHC

C10. How did you pay for the preventive/precautionary measures selected **in question C**7?

1. Personal/Household resources [ ] 2. Joint contribution with Other Households [ ]
3. Landlord/ lady [ ] 4. Other (specify) ____________________

C11. If you lost property/assets provide information about the type of property lost?

	Description	Number
a.	____	______
b.	____	______
c.	____	______
d.	____	______

C12. If anybody in the household lost equipment provide information about the type of equipment lost?

Number	Description	
a.	____	______
b.	____	______
c.	____	______

C13. How long did the flood/storm water take to recede? _____________ days

D. Last or Latest Flood Experience

D1. When was the last time you experience a flood (water entering homes/compound)? ______ year ago

D2. Did you undertake any precautionary measure before the **latest/last flood event** you experienced in this community?

1. Yes [ ]   2. No [ ]

If Yes in D2, Go to Question D6

If No in D2, Go to Question D3

D3. If **no in question D2**, why did the household not take any precautionary measures against the **latest/last flood event**?

		1. Yes	2. No
i.	Did not know what to do/No one to turn to	[ ]	[ ]
ii.	No Money	[ ]	[ ]
iii.	Prevented by the landlord/lady	[ ]	[ ]
iv.	Floods are not that severe	[ ]	[ ]
v.	I believe floods will not happened again	[ ]	[ ]
vi.	No protection is adequate against floods in the community	[ ]	[ ]
vii.	I have gotten used to the flood	[ ]	[ ]
viii.	Other (Specify) ______________________________	[ ]	[ ]
ix.	Other (Specify) ______________________________	[ ]	[ ]
x.	Other (Specify) ______________________________	[ ]	[ ]

D4. If **yes in question D2**, what factors did you consider in choosing the adaptation measure/measures?

		1. Yes	2. No
i.	No/Cheaper Cost	[ ]	[ ]
ii.	Able to use family and friends as support/labour	[ ]	[ ]
iii.	Have family/friends living in other parts of the city	[ ]	[ ]
iv.	We felt we could do it ourselves	[ ]	[ ]
V.	Believed that option was the best precautionary measures	[ ]	[ ]
vi.	Other (specify) ______________________________________		

D5. If **yes in question D2**, how did you get to know about the selected adaptation strategy (ies)?

1. Family [ ] 2. Friends [ ] 3. Neighbours [ ] 4. Other (specify) ________________________

D6. If **yes to question D2**, what did you do to protect your household (adaptation measures) prior to **the latest flood event**?

	Adaptation Measures	1. Yes	2. No
i.	**Filling the Compound with sand/refuse**		
ii.	**Sandbags to form protective barriers**		
iii.	**Raised building foundation or level of the kiosk/containers**		
iv.	**Raised door steps**		
v.	**Strengthen of doors and windows**		
vi.	**Construction of Protective/Retaining walls**		
v.	**Temporal Relocation ahead of heavy rainfall**		
vi.	**Cementing the floor of the compound**		
vii.	**Construct Drains**		
viii.	**Buy or Hire water pump to pump water out of home**		
ix.	**Arrange valuable property on wardrobes and shelves/ etc.**		
x.	**Seek Shelter on roofs/ higher buildings in the community**		
Xi	**Insurance**		
Xiii	**Susu (that allows to take some money after floods)**		
Xiv	**Complain to the landlord**		
Xv	**Complain to Assemblyman**		
Xvi	**Other (Specify)**		

D7. If **yes in question D6 (i to viii),** provide details on the cost of adaptation measures implemented?

Year ________________

a. Labour GHC ________________

b. Material (including transportation) GHC ________________

c. Other Cost GHC ________________

D8. If household who mentioned **susu or insurance in question E8**, how much did the household pay per month? ___________GHC

D9. How was the adaptation financed? ____________________

1. Personal Household resources [ ] 2. Joint contribution with Other Households [ ]
3. Landlord /lady [ ] 4.Other (specify) ________________________

D10. If (**yes in question D2)**, did any household member experience any of these conditions during or immediately **after the latest flood event**?

	Flood Related Losses	1. Yes	2. No
i.	**Loss of valuable property**		
ii.	**Lost business structure**		
iii.	**Lost business equipment/machines/inputs**		
iv.	**House (Portion)Structure**		
	Other(specify)		

D11. If the household lost property/asset as a result of the **latest flood**, provide information about the type of property lost?

Description **Number**

a. ____ ______

b. ____ ______

c. ____ ______

d. ____ ______

D13. If any household member lost equipment during **the last flood**, provide information about the type of equipment lost?

Description **Number**

a. ____ ______

b. ____ ______

c. ____ ______

d. ____ ______

D14. How long did the flood take to recede? ______________ days

E. Household Data

E1. Which of the following categories do your household belong to? _____________

1. Landlord [ ] 2. Relative of Landlord [ ] 3. Tenant [ ] 4. 5. Percher [ ]
6. Caretaker [ ] 7. Other (specify) ____________________

E 2. Sex of head of household? ______________ 1. Male [ ] 2. Female [ ]

E 3. Age of head of household? ____________ years

E 4. Educational status of head of household?

1. Pre-school [ ] 2. Primary [ ] 3. Middle/JHS [ ]
4.Voc/Comm/Tech [ ] 5. Secondary [ ] 6. Post sec/nursing [ ]
7. Tertiary [ ] 8. No Education [ ]

E 5. Highest educational attainment within the household?

1. Pre-school [ ] 2. Primary [ ] 3. Middle/JHS [ ] 4. Voc/Comm/Tech [ ]
5. Secondary [ ] 6. Post sec/nursing [ ] 7. Tertiary [ ] 8. No Education [ ]

E6. What ethnic group do you belong to? ___________________

1. Akan [ ] 2. Ga [ ] 3. Ga Adamgbe [ ] 4. Ewe [ ] 5. Guan [ ]
6. Dogbane [ ] 7. Grussi [ ] 8. Grumma [ ] 9. Hausa [ ]

E7. Marital status of head of household? ___________________________

1. Never married [ ] 2. Married [ ] 3. Consensual union [ ]
4. Divorced/Separated [ ] 5. Widowed [ ] 6. Other (specify) _________

F. Housing

F1. Type of dwelling

1. Compound house [ ] 2. Detached/Separate House [ ] 3. Uncompleted Building [ ]
4. Improvised home (Container, kiosk etc) [ ] 5. Others (Specify) _________________________

F2. Type of wall material?_______________ **(Observe)**

1. Cement blocks/concrete [ ] 2. Mud/mud brick/earth [ ] 3. Wood [ ]
4. Metal sheet [ ] 5. Landcrete [ ] 6. Other (specify) ________

F3. How does your household dispose of refuse? ____________________

1. Burning [ ] 2. Burying [ ] 3. Open Public Dump site [ ] 4. Public Container [ ]
5. Private Collector [ ] 6. Thrown anywhere [ ] 7. Other (Specify) __________________________

F4. What type of toilet facility does your household use? _________________________

1. Flush Toilet [ ] 2. Traditional Pit Latrine [ ] 3. Private KVIP [ ] 4. Public Toilet [ ]
5. Pan /Bucket [ ] 6. No Facility /Bush /Shore/Field/Stream/Lagoon [ ]
7. Other (specify) _______________________

F5. Major source of drinking water drinking for member of the household

1. Piped into dwelling [ ] 2. Piped into yard or plot [ ] 3. Public tap/standpipe [ ]
4. Protected well [ ] 5. Unprotected well [ ] 6. Tanker-truck [ ]
7. Cart with small tank/drum [ ] 8. Sachet water [ ] 9. Other (specify) _________

F6. Is there a concrete gutter (drain) in front of your house? 1. Yes [ ] 2. No [ ]

F7. If **yes in question F6,** describe the condition of the gutter in front of your house?

	1. Yes	**2. No**
i. Choked	[ ]	[ ]
ii. Cracked	[ ]	[ ]
iii. Narrow	[ ]	[ ]
iv. Lacks sloping (gradient)	[ ]	[ ]
v. Covered	[ ]	[ ]

G. Household Economy and Assets

G1. Which of the following assets does your household own **(Enter 1, when household have these assets in a working condition. Enter 0 when the household does not have the asset or it is not in a working condition)**?

Items	**Tick**	**Item**	**Tick**	**Item**	**Tick**	**Item**	**Tick**	**Item**	**Tick**
Television		***Video deck***		***Motor bike***		***Gas Stove***		***Furniture***	
Radio		***DVD/home theatre***		***Radio cassette player***		***Kerosene Stove***		***Standing Fan***	
Mobile phone		***Car***		***Refrigerator***		***Computer/ computer accessories***		***Sheep /Goat***	
Electric Iron		***Bicycle***		***Freezer***		***Sewing machine***		***Fowl***	
Cooking Utensils		***Suitcase***		***Box Iron***		***Coal pot***		***Mattress***	

H. Perceived Severity and Occurrence of Floods

H1. How do you perceive the **occurrence/frequency** of floods in this community in the next **ten (10) years**?

1. More [ ] 2. Same number [ ]
3. Less [ ] 4. I do not have an idea [ ]

H2. Provide reasons for answer in **question H1**

a.______________________________

b. ______________________________

c.______________________________

H3. How do you perceive the **severity of floods** in this community in the **next ten (10) years**?

1. More [ ] 2. Same [ ]
3. Less [ ] 4. I do not have an idea [ ]

H4. Provide reasons for answer **in question H3**

a.______________________________

b. ______________________________

H5. How do you perceive the **severity of floods** in this community in the **past ten (10) years**?

1. More [ ] 2. Same number [ ]
3. Less [ ] 4. I do not have an idea [ ]

H6. Provide reasons for answer **in question H5**

a. ______________________________

b. ______________________________

H7. How do you perceive the **occurrence/frequency of floods** in in the **past 10 years**?

1. More [ ] 2. Same number [ ]
3. Less [ ] 4. I do not have an idea [ ]

H8. Give reason for your answer **in question H7**

a. ______________________________

b. ______________________________

c.______________________________

I. Challenges to Flood Risk Reduction and Recommendations

I1. What challenges do you envisage will occur if an attempt is made to construct drains in this community?

a. ______________________________

b. ______________________________

c. ______________________________

I2. How can the challenges to effective drainage construction be dealt with in this community?

a. ______________________________

b. ______________________________

c. ______________________________

I3. What challenges do you envisage will occur in this community if a decision is taken by the authorities to enforce laws on reservations and buffer zones in the community to minimise the impact flooding in the community?

a. ______________________________

b. ______________________________

c. ______________________________

I4. How can the challenges to a decision to enforce reservations and buffer zone laws in the community be resolved?

a. ______________________________

b. ______________________________

c. ______________________________

I5. Other challenges to flood adaptation/protection in the community?

a. ______________________________

b. ______________________________

c. ______________________________

I6. Recommended solutions to the indicated challenges

a. ______________________________

b. ______________________________

c. ______________________________

PIN	Name	Sex	Age	Occupation	Marital Status	Ethnicity	Educational Status
	Write the complete list of all members of this household, starting with the <u>HEAD</u> of the household.	**1. Male 2. Female**	**Age in completed years**	**For Household Members with AGE 16 years and above**	**1. Married 2. Never Married 3. Consensual Union 4. Separated 5. Divorced 6. Other(Specify) 98 Not Applicable**	**1. Akan 2. Ga 3. Ga Adamgbe 4. Ewe 5. Guan 6. Dogbane 7. Grussi 8. Grumma 9. Hausa 10. Other (Specify)**	**1. No Education 2. Pre-school 3. Primary 4. Middle/JHS 5. Voc/Comm/Tech 6. Secondary 7. Post sec/nursing 8. Tertiary 9. Other (specify)**
	J1	**J2**	**J3**	**J4**	**J5**	**J6**	**J7**
Head							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
13							
14							
15							
16							
17							

APPENDIX B

Sample Interview Guide for Institutions Involved in Flood Adaptation

UNIVERSITY OF GHANA-LEGON

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH

ADAPTATION TO URBAN FLOODS AMONG THE POOR IN THE ACCRA METROPOLITAN AREA

Checklist for In-depth Interviews with Town and Country Planning Officer
Metropolitan Director

This interview guide is not meant to be completed by the Respondent. It is to facilitate discussions between the researcher and the respondent. It has been attached to the Introduction Letter so that the respondent is aware of the areas and issues to be discussed ahead of the interview.

A. BACKGROUND INFORMATION

Date & Time of meeting ……………………………………………….
Name of Office…………………………………………………………
Position of Officer …………………………………………………..
Reschedule Meeting ………………………………………………….

B. CHECKLIST OF ISSUES TO BE DISCUSSED

1. Details on planning and development control (Availability of planning schemes, proposed land uses especially along the water bodies)
2. Discussion of planning legislation, standards for rivers and other water bodies

The Role of the Institution in Flood Mitigation/Prevention (with particular reference to post 2010 floods)

3. The role of the Town and Country Planning Department in flood prevention in Accra
4. Collaborating institutions (private and public) in planning to minimise the effects of floods in flood prone communities in Accra
5. Assessment of interagency collaboration in flood mitigation (strengths, challenges etc)
6. Proposals (programmes, laws, policies, projects etc implemented in the past, being implemented or to be implemented) for flood mitigation/prevention in Accra by the public institutions etc (Cut-off date for past is the 2011 floods)
7. Any major policy, legislative and/or administrative decisions or actions taken after the 2011 flood in Accra to minimise the effects of floods on the residents of the city
8. Assessment of actions undertaken after the 2011 floods (success or failure). Explain with examples and reasons
9. Views on the power relations with other institutions and its effects on planning, development control/law enforcement, budget allocation (Evidence/Real/Perception)
10. Views on relationship with traditional authorities and its effect on zoning and development control (Experience/Real or Perception?)
11. Experience and/or perception of political backlash of law enforcement actions
12. Staff strength (availability of personnel) and impact on development control/law enforcement
13. Perception and/or evidence on corruption and negligence among staff and developers to build in reservations, waterways and other public spaces in flood prone areas (How can or does this occur?)
14. Views on the effects of residents' perception about the organisation, culture and informal networks (power brokers) on development control/enforcement of zoning regulations, which can reduce the incidence of flooding (Evidence based/Real or Perception?)
15. Programmes/projects for flood adaptation in Accra?
16. Level of consultation and participation in major flood mitigation projects in Accra

17. General challenges in planning to minimise the impact of floods in Accra, especially in depressed communities
18. Recommendations

THANK YOU

UNIVERSITY OF GHANA-LEGON

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH

ADAPTATION TO URBAN FLOODS AMONG THE POOR IN THE ACCRA METROPOLITAN AREA

Checklist for Focus Group Discussion at the Community Level

A. <u>BACKGROUND INFORMATION</u>

Date & Time of Meeting ……………………………………………………………
Name of Community/Locality ……………………………………………………..
Number Present: Male ……………………… Female……………………..…
Reschedule Meeting ……………………………………………………………….

B. <u>CHECKLIST OF ISSUES TO BE DISCUSSED</u>

1. Historical background of the community
2. Knowledge of any planning scheme for the area
3. Land ownership regimes in the community
4. Discussion on the causes of flooding in the community (including list of causes)
5. Ranking of causes of flooding in the community by members of the focus group

<u>Adaptation/Coping Strategies against Floods (Pre-Impact Measures)</u>

6. Current coping/adaptation measures (how households and community members organise themselves to minimise the adverse impact of flooding on the lives, property and livelihoods)
7. Type of coping strategies adapted by households
8. Emergence of community based association and flood mitigation

9. Role of community based associations (e.g. landlord association) in flood adaptation

The Role of Institutions in Flood Adaptation (Pre –Impact Measures)

10. Actors in flood prevention in the community (Perceived and Actual)
11. The role of the Assembly in flood adaptation (Perceived and Actual)
12. The role of the community in flood adaptation
13. The role of the households in flood adaptation
14. Proposals (programmes, laws, policies, projects etc implemented in the past, being implemented or to be implemented) for flood mitigation/prevention in the area by the community, civil society, public institutions, Member of Parliament etc. after the 2010 flood
15. Local taboos, norms, rules that support or militate against flood adaptation
16. Actors involvement in flood adaptation (state and non-state actors)
17. Assessment of the performance of public institutions involved in flood mitigation
18. Building in water courses, reservations and public open spaces, poor refuse disposal practises; views and remedies
19. Past positive and negative encounters with public institutions' involved in town planning and protection of water bodies (e.g. Town and Country Planning Department) and it influences relations with the particular institution
20. Expectations of flood adaptation support from the Assembly
21. Recommendations on how to reduce the impact of future floods in the community
22. Any other issues related to subject

THANK YOU

Appendix C

Letters

GLEFE COMMUNITY DEVELOPMENT ASSOCIATION

Tel: + (233) 0547328881
+ (233) 0272744722

P. O. BOX MP 636
MAMPROBI – ACCRA
23RD NOVEMBER, 2011.

THE DANSOMAN DISTRICT DIVISIONAL POLICE COMMANDER
ACCRA.

GLEFE COMMUNITY DEV ASSOCIATION
DATE 23rd Nov
SIGN

Dear Sir,

NOTIFICATION OF COMMUNITY DEVELOPMENT ASSOCIATION

We the executives and on behalf of the entire membership of the Glefe Community Development Association (G.C.D.A) write to respectfully and officially inform you of the formation of the G.C.D.A. Clearly as formality demands in procedural approach we deem it fit and prudent as a noble and concerned District Divisional Police Commander to help streamline and any negative activities and tendency that may arise in the community. We will also do our best as a Civilized Association to create meaning to the target of policing to bring to your notice the existence of the Glefe Community Development Association.

Indeed, we believe in unity as a catalyst for change and axiom that propels development in changing lives, community and as a nation with tenacity of purpose and helping solve challenges in our community are primarily, our focus and drive.

Our major objective and cardinal pillars for the establishment of the Association, which is non chieftaincy related and non political are base on.

1. To address security, water and sanitation issues.
2. To assist and mobilize for Glefe community developmental projects.
3. To protect and safeguard the Glefe community (Community watch/Policing)
4. To organize symposium to find and solve problems facing the community.
5. To educate the community on health, social matters etc and voluntary exercise.

It is our humble appeal that whenever we need any clarity on certain issues and advises, we will not hesitate to consult you.

We also count on your support and corporation to address the Glefe Community challenges.

Thank you.

BLANKSON LARTEY
(CHAIRMAN)

Yours Faithfully,

J.S.K FREEMAN
(SECRETARY)

GLEFE COMMUNITY DEVELOPMENT ASSOCIATION

Tel: +(233) 0547328881
+(233)0272744722

P.O.Box Mp 636
Mamprobi -Accra

3rd September, 2013

Sub-Metro Director
Ablekuma South Sub-Metro
District Council

GLEFE COMMUNITY DEV ASSOCIATION
DATE

Dear Sir,

PROPOSAL FOR CONSIDERATION (GLEFE COMMUNITY NEEDS ASSESSMEN AND PROJECT LIST)

With reference to your letter dated 26th August, 2013 No. AS/INV./VII/069 captione invitation to a stakeholders meeting held on 3/09/2013 aim at helping A.M.A. to identify th felt needs of the people we represent/serve to enable A.M.A. prepare an annual ~~of~~ action pla (AAP) for the year 2014. As AMA is prepared to take note and act on our request for th betterment of our community to deepen decentralization. The Glefe community represente by the GCDA has these report and proposals to table for consideration.

The GCDA is a registered CBO and Non Partisan advocacy Association with its co objective centered on:

- Reviving the spirit of community volunteerism and participation for sustainab development.
- Protecting, safe guarding and prevention through research and symposium to find an help solve challenges facing the community with consultations to pursue an agenda o negative impart, coping strategies and sustainability.
- To assist and mobilize for Glefe community developmental projects.
- Educate and advocate for support to address security, water and sanitation, health ar social issues.

Based on Glefe History, observation, calculation analyses and consultations and grou discussions held, we can state on record that Glefe community is faced with enormou challenges which have culminated in loss of human lives, properties and affected econom activities over the years and now.

Motto: Unity and Improvement

Challenges Outline	Project to be Carried out
1. Artificial diversion of the Glefe lagoon to the sea which is not its tributary causing volume-metric rate of flood as is more often a combination of River Flood (prolong rainfall), costal flood (sea tide/ sea level rise) and Ground water flood (rise-up of water table level) NB: Glefe community has been experiencing perennial flooding during the least down pour due to the fact that it is the outfall of most of the drains within the West Accra metropolis and the most affected part is the West Corridor lane/zone.	1. (A) Big Drainage Systems to be constructed at the western corridor of Glefe (B) The Natural flow which links/joins other rivers right to Bortianor river must be allowed to flow freely and continuously. NB: The artificial diversion or manual/machine dredging has not help as it has its disadvantages hence the recurrence of flooding recorded.
2. Urban Coastal climate change risk/effect, as a result of coastal erosion/or sea waves from high tide. Glefe community has suffered severe danger (devastating effect) with total collapse of building and toilet projects.	2. Sea defense
3. Acute Health Challenges:- The Glefe CHIPS compound rent elapsed on 1st Nov. 2012 and finally vacated in March, 2013 and as a high rate of population density, inhabitants are not safe with pregnant women and children and aged suffering with health recorded and leading to increased health uncertainty.	3. Full community clinic
4. Poor road network especially the western corridor of Glefe where the population is highly dense.	4. Good motorable road at the western corridor of Glefe Community.
5. Poor sanitation and environmental health and negative human activities.	5. (A) Waste/Refuse Bins/ Containers to be put at vantage points at western corridor of Glefe. (B) Educate and sensitization programme for change.
6. Lack of research and information to forecast community future needs with changing trends as we have witness and experienced over the few years	6. Community (RILA) centre (Research, information, library and advocacy centre)

which never existed even 15 years ago per our history records.	
7. Lack of Government facilities and community development fund	7. (A) State of the art Toilet facility (B) Modern Schools complex (C) Community Market (D) Geographical location is super for tourism investment.

We humbly hope with great expectation that the AMA Annual Action Plan (AAP) for the year 2014 will capture these projects and others to solidly build and develop the Glefe Community from further burning issues and will better manage/help solve this current situation.

We also stretch a hand of cooperation and partnership to you for sustainable community development.

Thank you.

Yours faithfully,

Sign.................. 0295432393
Blankson Lartey
(Acting Chairman)

Sign....................... 027272...
JSK Freeman
(Acting Secretary)

Sign.................. I 0277148095
Naa Tetekor I
Glefe Manye (Queenmother)

0275722842
Sign.......................
Frank Akakpo Ameder
Head of Opinion Leaders

Sign.................. 0244730610
Gyesi Commey
Patron GCDA

Sign....................... 02761...
Owusu Affriyie
Founder & Acting PRO

Sign.................. 0287070608 5/09/2013
Hon. Emmf. BB. Boryor
Assembly man

Sign....................... 0266464408
Enoch Kofi Adotey
Acting Organiser

Motto: Unity and Improvement

(2)

GWDA GLEFE WEST DEVELOPMENT ASSOCIATION

P.O. Box MP 636, Mamprobi
Tel:+233 547328881
266644080

Date 6-8-11

Hon. Fritz Baffour

MP Ablekuma South

Accra.

Dear Sir,

PETITION

We the entire membership of the Glefe West Development Association and in collabration with the entire denizens or inhabitants at Glefe, inscribe to petition you (our MP) and by enlarged the Government of Ghana to come to our rescue and aid in addressing the critical challenges that affects us and even on our survival here at Glefe Community.

Indeed, base on observation s, calculation and analysis carried out by the Association Technical Committee as evidence, through their preliminary works indicates that the volume-metric rate of flood experienced as checked is more often a combination of River Flood (Prolong rainfall), Coastal flood(seatide) and Ground water Flood (Rise up of water table) which hinders productive activities and free flow of access, then again after the flood then diseases sets in, primarily being water borne type - Malaria, Typhoid etc.

These and many negative situations inconvenience us. Notably, deaths have been recorded as a result of the flood.

Therefore we humbly call for a multi-sectoral approach as the way forward to address the situation once and for all.

We still emphasize that if nothing is done to reverse these predicament within the immediate , medium and longterm as measures, then we will or can be convinced that the whole Glefe community will be submerged by the seatide and the rainfall some few years to come.

As an Association, we will not look on unconcern and see our only community to be submerged and its water bodies polluted, all in the name of Human Activities which can be controlled through education and calling on the Government and the expects for assistance all in the caption helping solve the problems.

We still call for an extensive research or inquest why it is so and the determination of the flood type against future occurencies and what can be done to avert the situation fully or completely involving the Meteorological Service, Geological Service, Environmantal Protection Agency, Ministry of Water Resources , Works and Housing, Accra Metropolitan Assembly , NADMO, Hydro Engineers, Surveyors/Contractors, Town and Community Planners, Chiefs/ Oppinion Leaders in the Glefe community and others.

Aside the challenges we face, the prime importance for our petition are these two(2) priorities we want to crave to be executed to address our major concerns;

1. Roads- Thoroughfare/access to road has been one of our challenges we will humbly plead to be constructed as a control measure.
2. Main Gutter -Drainage system chanelling to provide access for the water to flow directly to the sea - that is creating artificial passage for rain etc.

It is however our hope, vivid expectation and prayer that these projects will be erected or constructed to mitigate us from thes pressing and burning issues which forms our core or focal point at Glefe.

Thank You.

Yours Faithfully,

J.S.K. Freeman
(G.W.D.A. Secretary)

Raymond Angtor
(G.W.D.A. Chairman (Vi

GLEFE COMMUNITY DEVELOPMENT ASSOCIATION

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P.O.Box Mp 636
Mamprobi -Accra

29th February, 2012.

GLEFE COMMUNITY DEV. ASSOCIATION
DATE 29th Feb. 2012
SIGN

The managing Director
Panbros Salt Industry
Accra.

Dear Sir,

PROPOSAL FOR CONSIDERATION

We respectfully write to table this proposal which is attached to this letter for your study and consideration which is captioned proposal for an embankment construction.

Surely, base on critical guide – history, observation and calculation, the effort and consultations to minimize the flooding in the Glefe community is our paramount concern, as it have already caused harm to lives, properties and economic activities.

Thorough fare or access to free-flow of the Lagoon continuously will solve major aspects of the flooding cases as the way forward.

Naturally the Lagoon flows from Glefe, through Opete-kwei, then Tunga and then link to Sakumo and then Bortianor,15years ago and during the dry-season the Glefe Lagoon totally and drastically dries up completely, therefore the artificial diversion of the Glefe Lagoon to the sea is indeed not it tributary as it have rather worsen the flooding situations in the community.

1 However, we sincerely crave your indulgence to positively study the proposal for the necessary rectification through the construction of an embankment which must be geared towards creating relief of a sort to the entire denizens or inhabitants at Glefe to carry out their normal and extra ordinary duties without fear especially during the rainy season which now is not predictable.

MOTTO: UNITY AND IMPROVEMENT

We hope this our humble request or proposal would meet your kind consideration and endorsement and the Glefe entire community will never forget your great and super effort in assisting us to achieve a lasting solution.

We will laudably commend you for showing complete love, generosity and a leaving a lasting legacy for the community.

Thank you abundantly as we look forward to hear from you favorably.

Wishing you gracious and productive business.

GLEFE COMMUNITY DEV. ASSOCIATION
DATE 29th Feb. 2012
SIGN

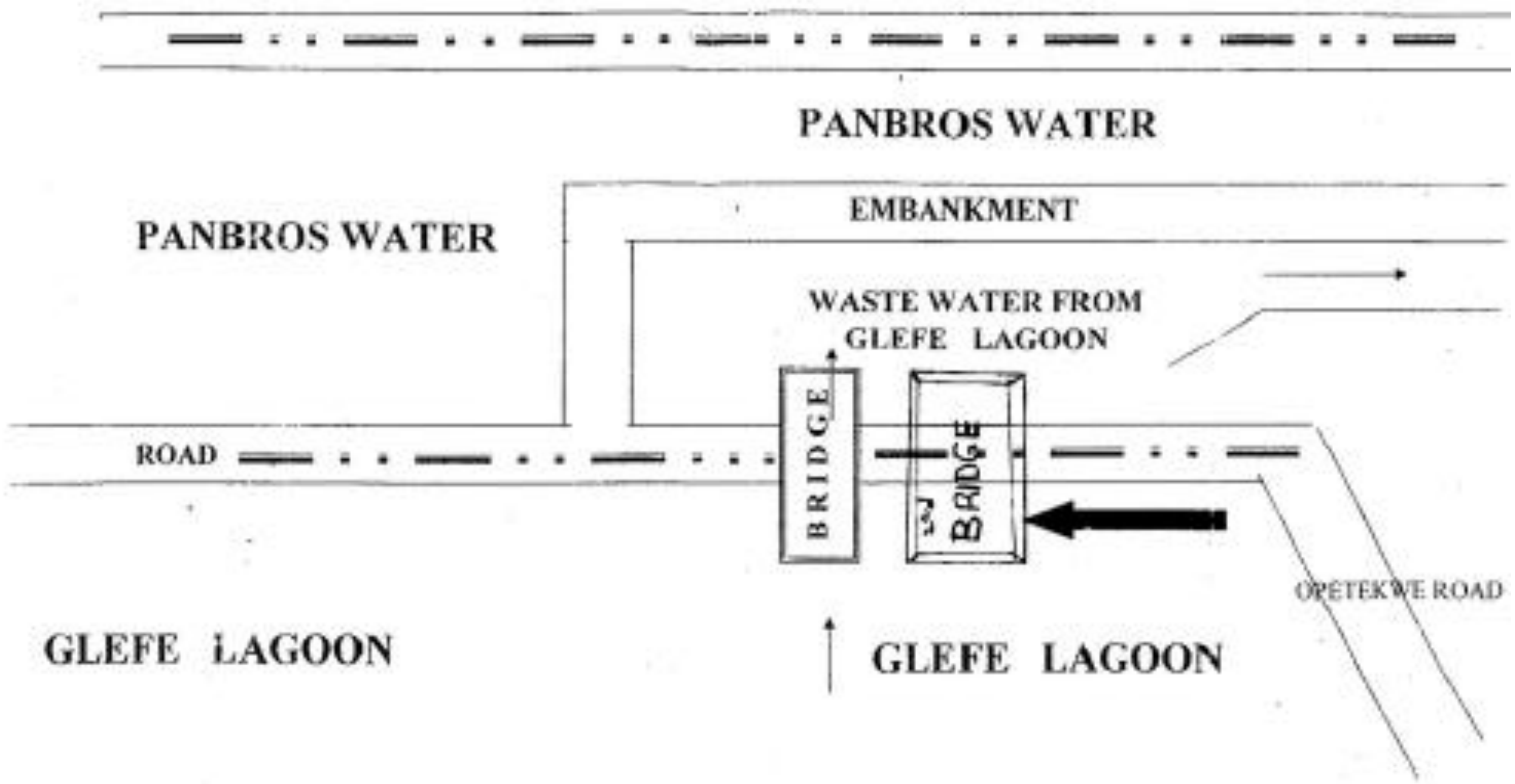
Yours faithfully,

Blankson Lartey
(CHAIRMAN)

J.S.K FREEMAN
(SECRETARY)

MOTTO: UNITY AND IMPROVEMENT

PROPOSAL FOR EMBANKMENT



Appendix D

Major Flood Events in Accra Since 1950

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
21st - 23rd June,1955	Adabraka, Agbogbloshie, Galloway, Railway station, Adiedienkpo, Large Areas around the Odaw river and Korle Lagoon.	77.7	N/A	• A train was trapped • 3 lives lost • Walls collapsed on pregnant woman and her daughter. • Many injuries were reported • Property were lost
2nd -3rd June, 1959	Selwyn market areas down Odaw Stream, Old Accra Electricity Station Area, Large areas of Achimota to the Guggisberg road and Korle Lagoon	192.0	N/A	• Properties were lost.
11th June, 1963	Large areas along Odaw River. Other areas in the Accra Municipality	79.5	64	• 5 lives and properties were lost
2nd June, 1968	Large areas along Odaw. Other areas in the Accra Municipality	80	67	• Properties lost.

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
19th -23rd June, 1973	Kaneshie, South Industrial Area. Areas around major drain namely Odaw, Onyasia, Nima, Awudome, Kpeshie, Klotey, Labadi, Dansoman, Bubuashie and North Kaneshie.	175.3	65	• 3 lives lost, 500 people marooned, properties damaged. • A car was plunged into the Odaw River with its driver.
27th May, 1978	Odaw basin and communities in southern wenches of the Odaw river were affected	77.5	34	• Life lost and properties damaged
20th June, 1983	Osu Klotey drain and Bank of Ghana quarters were affected. Also affected was the Awudome Area	46.3	N/A	• Houses pulled down and properties were lost
1st August , 1984	Areas around the Nima Drain, Odaw River, and Ring Road were flooded	75.6	N/A	• Walls collapsed
2nd May, 1985	Kwame Nkrumah Circle, Obetsebi Lamptey Circle, Aladjo, Caprice Bridge, Ring Road Industrial Area, Millet Factory and Pepsi Factory	85.1	N/A	• Several bags soaked 20,000 crates worth 10,000,000.00 million were destroyed.
2nd May, 1985	Modern furniture, Mechanical Lloyd, Blackwood Lodge and Ghana Rubber Industries.	69.5	N/A	• Many furniture were destroyed

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
4th May, 1986	Kwame Nkrumah Circle, Aladjo, Avenor, Odawna and many areas	69.3	N/A	• 3 lives lost, P&T switching equipment worth ₵3.6 billion (old cedis) was damaged
22ndJune, 1987	Aladjo, Avenor Caprice Bridge, New Abbosey Okai, Mataheko, Nima Drain and Standfast Street	25.4	N/A	• Property were lost, walls collapsed and houses were pulled down by flood water
10th September,1987	Aladjo, Avenor Caprice Bridge, New Abbosey Okai, Mataheko, Nima Drain, Standfast Street	84	N/A	• Properties were lost, walls collapsed and houses were pulled down by flood water
3rd May, 1988	Tesano WABCO Estate, Kaneshie, Accra-Nsawam Road and Sun Lodge Hotel	112.5	N/A	• Walls/gates broken, Properties destroyed
2nd - 4th May 1988 **7th-8th June, 1988**	Obetsebi-Lamptey Circle, Kwame Nkrumah Circle, Industrial Area, Millet Factory, Old Dansoman, Chemu Lagoon, Ring Road West, Ghanaian State Insurance Reinsurance Corporation, State Insurance Corporation, Abbosey Okai, Kaneshie, Kpehe, Atico Junction, Mataheko, Dansoman, Aladjo, Mamobi, Ring Road South, North Industrial Engineers, Modern Furniture and Mamprobi (near Club Kakalika)	157.9 89.7	N/A	• 1 life lost, houses & sheds were destroyed many cars were grounded, traffic was disrupted, property and merchandises were also damaged • Schools and houses collapsed • 4 houses were damaged

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
8th - 10th May, 1989	North Kaneshie, Mataheko, Zongo Junction, Wlako Hotel, Bubuashie, Accra Academy, Industrial Area near Guinness Depot, Labadi, Labone Secondary School	14.4	N/A	• A number of children were trapped and 1 died • bridges and properties were damaged
27th-28th November 1990	Awudome, Nima, Kaneshie, Mataheko, Tesano, Aladjo, Nsawam Road, Achimota Railway Crossing and Accra Newtown	17.9 & 28.7	N/A	• Bridges houses collapsed • Roads destroyed
14th July 1991	Aladjo, Tesano, Avenor, Adabraka, Agege, Mataheko, Achimota and Taifa	157.2	N/A	• Lives, houses, roads, bridges were lost
5th December 1993	Nima	74.5	N/A	• Cars, hair dryers, personal effects, concrete slaps were washed away during the flood
5th- 6th June 1994	Mataheko Abbosey Okai, Nima Mamobi, Dzorwulu, Teasno, Kwame Nkrumah Circle. Aladjo, Asylum Down, Modern Photo Works, Neoplan Station	63.4	N/A	• Paloma Shopping Centre reported damaged worth ₵ 80 million, • 8 lives were lost when taxi cab No. 8127 plunged into the Aladjo drain.

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
4th July, 1995	Alajo, Achimota, Adabraka, Nima, Asylum Down, Labadi, Laterbiorkoshie Chorkor, Kaneshie, South Industrial Area, Agbogbloshie, Alajo, Avenor and Abelemkpe were flooded. Most affected areas were in Odaw and Oyansia basins	243.9	42	• The heaviest single rainfall event in Accra since 1936. • About 15 hours rain in Accra over a 5 hour period. Activities in Accra come to a standstill. • Seventeen (17) people were reported dead. • Later on 15th July the UN humanitarian department Flood situation report estimated that the death was 40. • Over 1,000 families were reportedly displaced in the process. • Properties and infrastructures worth thousands of dollars were also reportedly destroyed, and economic activities disrupted (Aboagye, 2012a).
24th October, 1998	Mallam, Gbawe, Alajo, Avenor, valley area of McCarthy Hill, Dansoman, and New Achimota, Tettheh Quarshie Circle	150.7	-	• Five (5) people lost their life in the flood

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
26th June, 2001	Tetteh-Quarshie Interchange	123.3	96	• Violent storms and rains , described by meteorologists as the heaviest since July 4, 1995 hit the metropolis. According to Songsore et al.(2009) • Six (6) people were killed but Aboagye (2012) reckons that the number dead is twenty three (23). Two (2) bridges caved in, one at Secaps Hotel near the Tetteh-Quarshie interchange and the other on the Spintex road.
6th September, 2001	Western Accra including communities like Mpoase, Glefe, Gbegbeysie and Chorkor	N/A	N/A	• Western Accra was flooded from an early downpour obstructing movement of commuters, especially those traveling to the city centre.
6th January, 2002	Odawna, Abossey Okai, Madina, Kaneshie, Graphic road, Awoshie and the Spintex Road.	-	48	• A three-hour downpour affected low-lying suburbs of Accra. Floodwaters from the Odaw River filled living rooms and open compounds. In some areas choked drains caused flooding. Three (3) persons reportedly died due to the floods

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
6th June, 2002	Kwame Nkrumah Circle, Odawna, Abossey Okai, Sodom and Gomorrah (Old Fadama), Agbogbloshie, Sakama, Dansoman Otorjor and other low-lying areas.	-	67	• The floods caused traffic congestion, business in affected areas came to a standstill as workers and pedestrians could not commute or had a hard time commuting. • Floods disrupted businesses and hampered commuting residents to the central business district and other destinations. • The military rescued distressed residents with boats at Dansoman Otorjor.
January, 2003	South Industrial Area, Odorkor and Awoshie	N/A	N/A	• Flooding in South Industrial Area, Odorkor and Awoshie. • Commuting was disrupted.
11th June, 2003	Otorjor and Exhibition at Dansoman, Banana-Inn, Teshie, Sowutoum, Asylum Down, Adabraka, Alajo, Avenor, Kwame Nkrumah Circle, Anyaa, Fan Milk near Ablekuma and Graphic Road were some of the worst affected areas.	89.3	N/A	• Knee-deep floods along watercourses. In Tema, affected communities included the Naval Base, Ashiaman Underpass, Timber market and Coastal Estates on Spintex road. • Floods water went as high window level of buildings in some of the affected areas. • Floods destroyed houses because of inadequate drainage in Teshie.

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
14th June, 2004	Asylum Down and Kwame Nkrumah Circle	97.6	45	• Heavy rains washed away roads. A road linking the Kwame Nkrumah Avenue was also washed away.
24th March, 2005	Asylum Down, Obetsebi Lamptey Circle and Mortuary Road.		-	• Major flooding occurred at Asylum Down. Most affected areas were Streets along the Odaw River; the rains also washed away sections the Obetsebi Lamptey Circle and Mortuary road.
26th March, 2007	Gbawe, Sowutoum, Mallam, Santa Maria and Kwashie-bu, Sakaman, Circle Odornaa Shopping Mall, Darkuman	59.2	58	• Kiosks and buildings in the affected areas were swept away by flood waters. Traffic jams reported at Darkuman Junction. Businesses were disrupt as huge volumes of silt and garbage were deposited in front of business **(Source: Ghana New Agency 27th March, 2007)**

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
5th April, 2008	Oblogo, Kwame Nkrumah Circle, Odawnaa Shopping Mall Area, North Kaneshie and Weija area were affected	N/A	27	• At the Odawna Shopping Mall, water from the nearby drain forced its way into the market and flooded some sheds, destroying some wares in the process. The traders had to flee the market for their lives. • In North Kaneshie the main drain could not accommodate the flood water because it was clogged with refuse. Walls of buildings collapsed as result of the floods **(Source: People Daily Graphic, 7th April, 2008)**
19th June, 2009	Mataheko, Kaneshie and Mallam, Abossey Okai, Mallam Junction, Sakaman, Awoshie, Santa Maria, Odorkor, Darkuman Junction, Atico Junction, North Kaneshie, Mpampromu and the Obetsebi-Lamptey Circle		N/A	• Seven (7) confirmed dead by the Ghana Police Service. • Floods washed vehicles and caused crashes. • 15,616 displaced and GH₵ 1,777,214.00 worth of items destroyed in Accra. • The Kaneshie-Mampromu road and Kaneshie-Mallam section of the Accra-Cape Road were damaged. • Some houses in low lying areas were filled with water, at some places above window level **(Source: NADMO, 2009/Ghana News Agency Report, 20th June, 2009)**

Year	**Worst Affected Areas**	***Volume (mm)**	***Intensity (mm/h)**	**Extent of Flood Severity or Damage**
21st May, 2010	Ashiaman, Tema Adenta and the western part of Accra	N/A	N/A	• Four (4) peoples died in Adenta. • The flood water swept away vehicles and other properties. • People were trapped on roof tops, trees and on top of walls. Several houses were submerged and roofs were ripped off. Trees and electricity poles were uprooted
20th June, 2010	Tema, Ashyie and Kpone	120.0	N/A	• Thirteen (13) people confirmed dead in the Ashiaman. • About 200 people were displaced as result of the downpour and flood.
22nd August, 2010	Glefe, Mpoase, Pambrose, and other low lying coastal communities in the western corridor of Accra	N/A	N/A	• Tidal waves destroy over 20 homes in Glefe alone and rendered over 100 families homeless. • One (1) person was reported dead as a result of this incident. • A similar incident occurred in September 2008 that lead to the amputation of the leg of one of the flood victims

Year	Worst Affected Areas	*Volume (mm)	*Intensity (mm/h)	Extent of Flood Severity or Damage
26th October, 2011	The most areas of the Accra–Tema metropolis, stretching as far as Kasoa in the Central Region were affected. Worst affected areas include Ashiaman, Motorway and Motorway underpass, Sakumono village and Tema Community 3 and 11 in Tema. In Accra, Kwame Nkrumah Circle, Graphic Road, Dansoman, Abossey Okai, Agbogbloshie, Glefe, Mpoase Awoshi Area, Achimota Mile 7 etc.	97.7	59	• Drains, rivers and water bodies overflowed their banks. Water in some cases rose up to window level. • Fourteen (14) persons lost their lives. • 43,000 persons were affected, 17,000 were rendered homeless. • The military, police, Ghana National Fire Service and NADMO were involved a major rescue and recovery missions across the city. • Traffic jams, vehicular accidents reported and business activities came to a standstill. • Major roads in the metropolis like the Graphic road, Accra-Tema Motorway, Ashiaman underpass and the Accra-Winneba road were damaged. • Other infrastructure affected included bridges. • A cholera epidemic broke out immediately after the floods with 100 cases reported. • The Minister of Education ordered the closure of basic schools in the metropolis.

Source: Adinku (1994); Songsore et al. (2009); UNPD/OCHA, 2012; Aboagye (2012a) and Media Reports .Volume and intensity Figures are obtained from Ghana Meteorological Department. N/A means that data not available from Ghana Meteorological Agency Data base