

**DIFFERENTIAL VULNERABILITY AND ADAPTIVE RESPONSES TO
CLIMATE CHANGE-RELATED HAZARDS IN INFORMAL URBAN
SETTLEMENTS IN ACCRA, GHANA**

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I, Ishmael Adams declare that this thesis is submitted in fulfilment of the requirements for the award of a Doctor of Philosophy Degree in Built Environment, in the Faculty of Design, Architecture and Building (DAB), University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Format of the Thesis

In line with **section 9.1.1** of UTS Graduate Research Candidature Management, Thesis Preparation and Submission Procedures, this thesis is categorised as a **conventional thesis**.

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ABSTRACT

Current processes of informal urbanisation and marginalisation of informal dwellers, present a challenge for sustainable adaptation to climate change in cities of developing countries. At present, over half of the global population live in urban areas while much of future urban growth would be in Africa and Asia. Yet, the nature of urbanism in these continents is characterised by persistent informal settlements, where disproportionate effects of the imminent climate crisis are likely to fall. In spite of this recognition, studies that analyse the vulnerability and adaptive responses of informal settlements' residents in Africa remain few and excessively focused on the analysis of vulnerability to flooding hazards. Moreover, by the theoretical frameworks and ontological positions often adopted in these studies, the opinions of the actors, which have the potential to provide contextual explanations for the drivers of their vulnerability, tend to be overlooked. This study partly departs from this dominant ontology, as it examines the drivers of informal settlements' residents' vulnerability and adaptive responses including to wider climate change-related hazards from an actor perspective.

The study which used Accra (Ghana) as a case, applied a mixed-methods approach. This involved the collection of data through households' surveys (582 households), key informant interviews (16 sessions) and focus group discussions (14 groups) with community level and state actors. Its central argument is that patterns of differentiation in vulnerability to hazards among residents of informal settlements in Accra are underpinned by socio-economic, political and institutional factors as a contextual experience. Factors associated with the respondents' 'perceived vulnerability' are their tenancy status, size of household income, length of stay in a community and perception of 'threats of eviction' over their land. However, the residents, who are active agents, do apply their individual and collective agencies in responding to their vulnerabilities, including climate change-related hazards.

This study, therefore, recommends three entry points for addressing the vulnerabilities of informal settlements' residents and to climate change. First is the need for local authorities to address the challenge of 'threats of evictions' in informal settlements. Second, is the need to recognise and integrate local knowledge of climate change in vulnerability assessments, and third is to recognise and integrate the differentiated household and community capacities in the implementation of a participatory slum upgrading intervention in Accra. Doing so will require a paradigm shift in urban planning practice in Accra and similar contexts. The study thus extends the discourse of social vulnerability and adaptive capacity in the wider debates on sustainable urban development.

LIST OF ACRONYMS

AMA	Accra Metropolitan Assembly
CBO	Community-Based Organisation
COHRE	Centre on Housing Rights and Evictions
COP	Conference of Parties
CSO	Civil Society Organisation
ENSO	El Nino Southern Oscillation
EPA	Environmental Protection Agency
FGD	Focus Group Discussion
GAMA	Greater Accra Metropolitan Area
GDP	Gross Domestic Product
GHAFUP	Ghana Federation of the Urban Poor
GIS	Geographic Information System
GMA	Ghana Meteorological Agency
GoG	Government of Ghana
GPRS	Ghana Poverty Reduction Strategy
GPS	Global Positioning System
GSGDA	Ghana Shared Growth and Development Agenda
GSS	Ghana Statistical Service
HM	Housing the Masses
ILGS	Institute of Local Government Studies
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
KLERP	Korle Lagoon Ecological Restoration Project
L.I.	Legislative Instrument
LA	Local Authority
LEAP	Livelihood Empowerment Against Poverty
MDAs	Ministries, Departments and Agencies
MEST	Ministry of Environment, Science and Technology
MLGRD	Ministry of Local Government and Rural Development
MoFEP	Ministry of Finance and Economic Planning
MTDP	Medium Term Development Plan

MWRWH	Ministry of Water Resources, Works and Housing
NADMO	National Disaster Management Organisation
NCCAS	National Climate Change Adaptation Strategy
NCCCS	National Climate Change Committee
NCCP	National Climate Change Policy
NDC	National Democratic Congress
NDPC	National Development Planning Commission
NGO	Non-Governmental Organisation
NPP	New Patriotic Party
NRC	National Redemption Council
NUP	National Urban Policy Framework
OCHA	Office for the Coordination of Humanitarian Affairs
OPEC	Organisation of Petroleum Exporting Countries
PDHS	People’s Dialogue on Human Settlements
SAP	Structural Adjustment Programme
SDGs	Sustainable Development Goals
SSNIT	Social Security and National Insurance Trust
TCPD	Town and Country Planning Department
UDU	Urban Development Unit
UESP	Urban Environmental Sanitation Project
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Organization
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Human Settlement Programme
UNISDR	United Nations International Strategy for Disaster Risk Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UTS	University of Technology Sydney
WRC	Water Resources Commission

LIST OF LEGISLATION AND ACTS

Act 2 Land Development (Protection) of Purchaser Act, 1960
Act 123 Lands Act, 1962
Act 125 State Lands Act, 1962
Act 29 Criminal Codes, 1960
Act 151 Business Name Act, 1962
Act 179 Company Registration Code, 1963
Act 462 Local Government Act, 1993
Act 478 Ghana Investment Promotion Act Centre, 1994
Act 517 National Disaster Management Organisation Act, 1996
Act 651 Labour Law, 2003

Act 682 Ghana Meteorological Service Act, 2004
Act 921, Zongo Development Fund, 2017,

Act 925 Land Use and Spatial Planning Act, 2016
CAP 84 Town and Country Planning Act, 1945
L.I.1630 National Building Code, 2012
L.I.1629 National Building Regulations, 1992

1 CHAPTER ONE: INTRODUCTORY BACKGROUND, PROBLEM STATEMENT, AND MOTIVATION

1.1 Background

The current processes of urbanisation, coupled with the imminent climate crisis raise questions about how residents of informal settlements will sustainably adapt to future climate change. Today, more than half of the world's population lives in urban areas, a number projected to increase to almost three-quarters in the next three decades (United Nations Department of Economics and Social Affairs [UNDESA] 2018). Yet, while much of future growth in urban population will be in Africa and Asia (UNDESA 2018), the nature of urbanism in these continents has been characterised by persistent informal economic activities (Brown, McGranahan & Dodman 2014; Vanek et al. 2014) and settlements (United Nations Human Settlements Programme [UN-HABITAT] 2009). This persistence of informal settlements is in spite of over half a century of their forced evictions in many cities in Africa and Asia (Dovey 2014; McFarlane 2012).

Closely related to the challenge of informal urbanisation is the challenge of climate change to urban dwellers in developing countries (Evariste et al. 2018; Jabeen & Guy 2015; Khalil et al. 2018; Leal Filho et al. 2018). Several coastal cities in developing countries are vulnerable to climate change-related hazards such as flooding, heatwaves and storms, all of which have been projected to increase, introducing new risks to urban dwellers in the coming years (Eriksen, Nightingale & Eakin 2015; Revi et al. 2014). An understanding of the nature of the vulnerabilities and responses to climate change-related hazards in informal settlements is thus crucial for planning towards the sustainable adaptation of cities in developing countries (United Nations 2015).

However, the extant literature as mainly theorised within political ecology has also been excessively focused on analysing informal settlements' dwellers' vulnerability to flooding hazards (see, Adelekan 2010; Ajibade & McBean 2014; Balgah, Bang & Fondo 2019; Douglas et al. 2008; Pelling 1997; Zoleta-Nantes 2002). The narrative from these studies has often emphasised how socio-economic, political and institutional factors account for informal settlements' dwellers' marginalisation and vulnerability to flooding hazards. For instance, in a study of five African cities (Accra, Nairobi, Kampala, Lagos and Maputo), Douglas et al.

(2008) reported a wide range of impacts of flooding, including the loss of basic livelihoods, the spread of waterborne diseases and loss of lives in informal settlements.

However, by the theoretical frameworks and ontological positions of these studies, residents of informal settlements have often been presented as ‘passive victims’ of flood hazards. The opinions of the actors, which have the potential to provide contextual explanations for the factors that drive their perceived vulnerability to the wider climate change-related hazards they face, tend to be overlooked. The point of departure of this thesis from this dominant discourse is an examination of the drivers of informal settlements’ residents’ vulnerability including the varied climate change-related hazards they experience from an actor perspective.

Using the city of Accra (Ghana) as a case, and applying mixed methods approach, the central argument of this thesis is two-fold. Firstly, patterns of differentiation in vulnerability among residents of informal settlements to climate change-related hazards are underpinned by socio-economic, political and institutional factors, as a contextual experience. However, the residents of informal settlements who are ‘active agents’ and with the knowledge of climate change, do apply their individual and collective agencies in responding to their vulnerabilities, including climate change-related hazards. This argument has been pursued within the theoretical boundaries of social vulnerability to hazards and underpinned in political ecology and actor-oriented theory.

The rest of this chapter is divided into five sections. It first outlines the problem statement of the research. Following this are the research questions in the second section. Emanating from the research gap and questions, are the aim and objectives in the third section. Section four of the chapter covers the motivation and justification, while the final section covers the organisation of the entire thesis in eight chapters.

1.2 Problem Statement: Informal Urbanisation, Human Vulnerability and Climate Change in Accra

Accra, like other cities in the developing world, which currently experience informal urbanisation (AMA & UN-HABITAT 2011), has also been affected by global climate change-related hazards, such as flooding, sea-level rise and storms (MEST 2013). Today, over 74

percent of the Accra Metropolitan Assembly Area's labour force depends on the informal economy for their livelihoods (Ghana Statistics Service [GSS] 2014). This percentage is much higher than the city's population (40 percent) who did so in 2000 (Grant & Yankson 2003b). Added to this is an equally high proportion (approximately 60 percent) of residents of Accra who reportedly dwell in informal settlements (AMA & UN-HABITAT 2011).

Several scholars have shown various socio-political processes through which informal dwellers and workers become marginalised and vulnerable in Accra (Adaawen & Jørgensen 2012; Anyidoho 2013; Anyidoho & Steel 2016; Asiedu & Agyei-Mensah 2008; Brown, Lyons & Dankoco 2010). This scholarship shows that while informal economic activities are predominant in the city, households who depend on the informal economy for their livelihoods continue to be evicted by the local authorities for conducting their economic activities in unauthorised places. Evictions in informal settlements have been reported to be harsher, apparently due to the relative importance of informal economic activities to Accra's urban economy (Amoako 2015; Bob-Milliar & Obeng-Odoom 2011; Obeng-Odoom 2011b, 2011c). In so doing, many residents of informal settlements become excluded from the planning processes and provision of social amenities, such as drainage infrastructure in their communities (Amoako & Inkoom 2018).

This challenging socio-economic and political living environment is further complicated by climate change-related hazards such as flooding, excessive heat and storms to mention but a few. Official data on Accra shows a steady rise in average temperature over the past 40 years, and rainfall patterns have also become more erratic (MEST 2013). Moreover, the Intergovernmental Panel on Climate Change (IPCC) model ensemble suggests changes in rainfall patterns and a change in the mean monthly precipitation from about 90mm to about 80mm over the months June, July and August (Codjoe & Owusu 2011). In addition to less predictability of rainfall patterns, residents of the city have become more susceptible to groundwater salinity, due to saline water intrusion into the aquifer (Ackah et al. 2011; Gyamfi et al. 2012).

Added to the challenge of groundwater salinity is a rise in sea level of up to 2.1mm per year over the last three decades and projected to further rise to 34.5cm by 2080 (MEST 2013). This rise in sea level, coupled with strong sea waves, have been associated with coastal erosion in

the city (Appeaning Addo & Adeyemi 2013). In addition to coastal erosion, studies suggest that about 0.48km of coastal communities will become inundated by the middle of the present century (Amoani, Appeaning-Addo & Laryea 2012; Appeaning Addo & Adeyemi 2013). Furthermore, by its location along the coast, and with a generally low lying topography, Accra is also at risk of flooding (Appeaning Addo & Adeyemi 2013).

Undoubtedly, both physical and social factors influence a household's or community's vulnerability to floods and other climate change-related hazards (Blaikie et al. 2014). Flooding in Accra is not a new phenomenon, the most notable occurrence of which took place in 1936; but this appears to have become more recurrent with more significant impacts in recent times (Ahadzie & Proverbs 2011). More than a hundred thousand people were recorded homeless and twelve (12) dead in June 2001 from flood hazards in Accra (Karley 2009), while flooding that occurred in October 2011 displaced approximately 17,000 people with fourteen (14) recorded deaths (United Nations Environmental Programme [UNEP] & United Nations Office for the Coordination of Humanitarian Affairs [OCHA] 2011). The effects of flooding on residents of Accra in 2010 were relatively higher; an estimated 5,188 people were affected with 22 deaths recorded (UNEP & OCHA 2011). A further 6,888 residents of the city were affected in 2012, while much higher 16,806 were displaced, including five (5) deaths in 2014 from flood-related hazards (UNEP & OCHA 2011). However, the most significant flood event which occurred in 2015, led to the displacement of about 30,688 people in the Greater Accra Region, and 135 deaths recorded in the Accra Metropolis alone (Appiah 2015).

Furthermore, the effects of flooding in Accra have not always been limited to residents of marginalised communities; but households who reside in informal settlements are said to bear the brunt (Aboagye 2012a, 2012b; Amoako & Frimpong Boamah 2015; Mumuni 2013). This knowledge is against the backdrop that, the local authorities by law [section 10 (3) of the Local Government Act 1993 (Act 462)], have to ensure the overall development and welfare of all residents of the city. Recognising this mandate, the stated mission of the Accra Metropolitan Authority (AMA) is to:

Improve the quality of life of the people of the city of Accra especially the poor, vulnerable and excluded by providing and maintaining basic services and facilities in the areas of education, health, sanitation and other social amenities in the context of discipline, a sense of urgency and a commitment to excellence (AMA 2014, p.1).

The Accra Metropolitan Authority (AMA), is mindful of this mandate but also grappling with the combined challenge of informal urbanisation and the imminent climate crisis. This challenge was noted by a mayor of Accra in 2015, when he called for the eviction of residents of an informal settlement for exacerbating the flooding problem in the city, as he noted that:

We have a mandate to see to the development of every part of this city, including the vulnerable populations who live in poor communities. Yet we are in an era of climate change. Nobody ever thought that the level of rain that we had three weeks ago could come upon us; and if the right thing is not done, we may all not live for the next election. So it is not a matter of elections; it is a matter of doing what is right to save lives now. We will have to evict the people of Old Fadama to clear the way for the water to flow (Issah 2015 p.5).

The persistence of the challenges posed by informal urbanisation and climate change, therefore raise the critical question of how the local authorities can sustainably meet their mandate to the residents. Doing so will include sustainably responding to climate change-related hazards in all parts of the city.

Recognising the potential impacts of climate change, a number of scholars have assessed vulnerability to climate change-related hazards in informal settlements in Accra (Abeka 2014; Aboagye 2012a, 2012b; Afeku 2005; Amoako & Inkoom 2018; Amoani, Appeaning-Addo & Laryea 2012; Appeaning Addo & Adegemi 2013; Karley 2009). For instance, Amoani, Appeaning-Addo and Laryea (2012) have shown how residents living along the western shoreline have been affected by sea erosion; about 0.48 km of their scarce land will be inundated by the middle of the present century.

To other scholars such as Aboagye (2012), Afeku (2005) and Karley (2009), the vulnerability of residents of informal settlements to flooding is accounted for by the city's high population growth rate and a dysfunctional urban planning system. This discourse has been advanced by Amoako (2015) and Amoako and Inkoom (2018) who point to historical social, economic and political processes as accounting for the marginalisation and vulnerability of residents of informal settlements to flooding. Overall, in addition to the limited thematic focus of these studies on flooding, this scholarship has tended to overlook the perspectives of the affected communities, in determining the exact drivers of their vulnerability to the wider climate change-related hazards they face.

A notable exception to these studies which more broadly examined climate change is a study conducted by Codjoe, Owusu and Burkett (2014) in three underprivileged communities. This study found that residents of the three case study communities have local knowledge, which can complement scientific knowledge for planning a response to climate change in the city. This notwithstanding, the potential synergies of this knowledge with the scientific knowledge of climate change remain unexamined, although considered essential for adaptation planning as has been argued by Abeka (2014).

Similar to the studies on vulnerability, several scholars have examined the adaptive responses to flooding risks in informal settlements in Accra (Abeka 2014; Aboagye 2012b; Mumuni 2013; Twum & Abubakari 2019). Aboagye (2012) in his study among homeless people and residents of Alajo community, found that women and tenants were less able to take flood mitigation measures than men and property owners. This was accounted for by the differences in their access to resources. Advancing this discourse, Abeka (2014), determined the correlates of socio-economic and psychological factors of household heads, with their adaptation options to flood hazards in three informal settlements. The study found four determinants of a household's adaptive responses to flooding as: 1) household's tenancy status; 2) nature of proximity of their dwelling to a drain; 3) the nature of wall material they used to construct their dwelling; and 4) their length of stay in the community. Nevertheless, the relationship between the diversity of socio-economic characteristics of the households, and their adaptive responses to the different climate change-related hazards they perceive and experience remains unexamined.

Overall, three critical knowledge gaps appear evident in these studies. First is the dearth in the knowledge of the exact contextual drivers of perceived vulnerability including climate change in the varied categories of informal settlements in Accra Metropolitan Area. Second is a knowledge deficit on the relations between the contextual socio-economic characteristics and knowledge of climate change in the informal settlements. The final knowledge gap is a deficit on the relations between the socio-economic and political characteristics and their adaptive responses to the wider climate change-related hazards in the informal settlements in the Accra Metropolitan Area. Together, the knowledge gaps pose a challenge to adaptation planning in the Accra Metropolitan Area. Critical information on informal settlements' residents' vulnerabilities and their adaptive responses are likely to be omitted from the adaptation policy-making and planning processes in Accra Metropolitan Area.

1.3 Research Questions

Three main critical questions that emanate from this research problem are:

- a) Which factors drive the perceived vulnerability of residents of informal settlements including climate change-related hazards as a contextual experience in Accra? Two related sub-questions are: 1) which social, economic, political and institutional factors are associated with the perceived vulnerability of residents of informal settlements to climate change-related hazards? and 2) what are the most frequently experienced climate change-related hazards among residents of informal settlements?.

- b) In which way does the context of residents of informal settlements influence their knowledge and ‘capacity to respond’ to potential climate change in Accra? Three embedded sub-questions are: 1) what are the perceptions of climate-related environmental changes among residents of informal settlements and the potential synergies with scientific knowledge on climate change-related phenomena? 2) how do socio-demographic characteristics of residents of informal settlements relate to their knowledge of climate change and variability compared to the perspectives of state officials on the same? and 3) how does the socio-political context of residents of informal settlements influence their access to an early warning on climate change-related phenomena?

- c) Who adapts to what and why in the context of climate change-related hazards and social vulnerabilities in informal settlements in Accra? Related sub-questions to this are: 1) what responses are adopted to minimise socio-economic contextual vulnerabilities, and how do they relate to climate change/variability in informal settlements? 2) how do socio-economic characteristics of residents of informal settlements relate to their adaptation options to climate change-related hazards in their built environments? and 3) what funding and/or support mechanisms are available for minimising social contextual and climate change-related vulnerabilities in informal settlements?

1.4 Research Aim and Objectives

Emanating from the knowledge gaps, this study aims to examine the factors that drive the vulnerability and adaptive responses of residents of informal settlements to climate change-related hazards as a contextual experience in Accra. Specifically, the study's objectives are to:

- a) Examine the drivers associated with the vulnerability of residents of informal settlements including climate change-related hazards as a contextual experience in Accra;
- b) Investigate the potential influence of the socio-economic context of the residents of informal settlements on their knowledge and capacity to respond to potential climate change in Accra; and
- c) Examine who adapts to what and why in the context of climate change-related hazards and social vulnerabilities in informal settlements in Accra.

1.5 Motivations and Justification of the Thesis

The motivations for this study are mainly two-fold. First, this study seeks to contribute to the discourse of social vulnerability, adaptive capacity and climate change, as well as sustainable urban development. The second main justification of the thesis is to contribute to urban policy-making and the practice of climate change adaptation planning, as presented in this section.

1.5.1 Extending the Social Vulnerability and Climate Change Discourse

It has been suggested that impacts of climate change are likely to fall disproportionately on residents of informal settlements, who are mostly located in hazardous urban spaces in cities of developing countries (IPCC 2012). This is in spite of the persistence of forced evictions of informal settlements in developing countries (Dovey 2014). This challenge has been compounded by climate change, which will introduce new risks to urban dwellers in the coming years (Leal Filho et al. 2018). An understanding of the present vulnerabilities of residents of informal settlements is thus crucial for planning towards a sustainable response to future climate change-related risks in cities of developing countries.

In spite of this recognition, the nature of vulnerability of the residents of informal settlements to the wider climate-related hazards they face, remains less understood, given its contextual nature and excessive focus of the extant scholarship on flood hazards (Leal Filho et al. 2018).

The dominant narrative in this discourse shows how social, economic and political factors account for the vulnerability of residents of informal settlements to flood hazards (see, for example, Adelekan 2010; Ajibade & McBean 2014; Douglas et al. 2008; Pelling 1997; Zoleta-Nantes 2002). Notwithstanding the limited scope of these studies on flood hazards, an analysis of the drivers of this vulnerability, has often presented community members as ‘passive victims’ of hazards. Thus, the opinions of the actors which have the potential to provide contextual explanations for the drivers associated with their vulnerability to hazards, tend to be overlooked.

Nevertheless, vulnerability to hazards is a contextual experience, influenced by the unique circumstances of the household, and can be determined, including the views of those who experience it (Adger 2006). By examining the drivers of the vulnerabilities of residents of informal settlements to climate change-related hazards, this study aims to provide a new perspective to the current discourse on socially differentiated vulnerability and hazards. Moreover, the study has the potential to generate lessons for how local authorities in Accra may respond to the vulnerabilities of the increasing informal settlements’ residents, given the imminent climate crisis.

1.5.2 Extending the Adaptive Capacity and Climate Change Discourse

The current impacts of climate change-related hazards in cities in Africa where overall adaptive capacities are low (Corburn & Sverdluk 2019) warrant an investigation into the adaptive responses to climate change in informal settlements. Indeed, urban areas in Africa are socially and spatially diverse; hence, the adaptive capacities of the residents to climate change-related hazards will not be evenly distributed across spatial and social groups. Among the numerous socio-spatial groups found in African cities are the marginalised urban dwellers who often live in hazardous locations, and most likely to bear the brunt of climate change (Leal Filho et al. 2018).

Notwithstanding this recognition, the current scholarship on adaptive capacity and responses of households in informal settlements has been excessively focused on analysing responses to flooding hazards (see, Abeka 2014; Chatterjee 2010; Isunju, Orach and Kemp 2016). This is also the case for the scholarship on adaptation in Accra (Abeka 2014; Amoako 2015; Amoako & Frimpong Boamah 2015; Amoako & Inkoom 2018; Mumuni 2013).

Nevertheless, current calls for sustainable urban development articulated in the sustainable development goals (SDGs), require action on: a) reducing inequalities in cities (SDG10); b) working towards sustainable cities and communities (SDG11); and c) taking action on climate change (SDG13) in urban areas (United Nations 2015). By examining the adaptive responses of residents of informal settlements to climate change-related hazards, this study will potentially generate findings of relevance for planning towards the sustainable development goals in Accra (Ghana).

1.5.3 Urban Policy-making and Climate Change Adaptation Planning Practice in Accra

Scholars have highlighted the need for socially inclusive policies that address the combined challenge of informal urbanisation and climate change in cities (Akbar, Minnery, et al. 2007; Dodman, Bicknell & Satterthwaite 2012; Shrestha, Ojha & McManus 2014). However, urban policy-making and adaptation planning practice in developing countries tend to pay little to no attention to the vulnerabilities and responses of informal settlements' residents to climate change (Shrestha, Ojha & McManus 2014). By examining the vulnerabilities of the residents of the four different informal settlements, this study aims to contribute to urban policy-making and climate change adaptation planning practice in Accra and similar contexts. The findings of this research also have the potential to contribute towards policy advocacy by civil society organisations who work with the urban poor in Ghana.

1.6 Thesis Structure and Chapters

Overall, this thesis has been structured into eight chapters, inclusive of Chapter One. Chapter One, which is the introduction of the thesis, covers the background, and the research problem, questions, aim and objectives. It also includes this outline of the thesis chapters.

Chapter Two presents the study context of informal urbanisation and climate change in Accra. It starts by giving an account of the nature of informal urbanisation, as influenced by historical political, economic and institutional processes over three main periods in the history of Ghana. This precedes an examination of the nature of climate change in Accra, showing the interconnections between the process of informal urbanisation and the exposure of residents of informal settlements to climate change-related hazards. It then examines the institutional and

policy contexts for the governance of informal urbanisation and climate change adaptation in the third section. The section includes the policy incongruences and their ramifications for residents of informal settlements. The chapter concludes by summarising the key points on policy inadequacies while advancing the need for a context-specific study of informal settlements' residents' vulnerability and responses to climate-related hazards in Accra.

Following Chapter Two, Chapter Three which covers a literature review includes a definition of the main concepts of the thesis, a literature review on empirical studies as well as the theoretical underpinnings and framework of the thesis. The first section of this chapter presents the definition of and an elaboration on the extent of informal urbanisation. This precedes a conceptualisation of vulnerability and its relationship with climate change in the context of informal urbanisation. The third section explores the concept of adaptation and its relation to climate change and sustainable adaptation in cities. Following these conceptual definitions, the fourth section of the chapter covers the empirical literature review. Areas covered in this review are the vulnerability, knowledge and adaptive practices of residents of informal settlements to climate change-related hazards, as well as the knowledge gaps to which this study responds. The last section of the chapter presents the integrated political-ecology and actor-oriented theoretical framework to contextualise the thesis, as informed by the empirical literature reviewed.

The methodology for examining the thesis's questions and case study contexts are presented in Chapter Four in five main sections. The first section covers the philosophical stance of the research, based on engagement in debates on research paradigm, epistemology, and ontology. An explanation of and justification of the case study is offered in the second section. The third section focuses on the methods applied by engaging in the debates on quantitative and qualitative research methods, as well as a justification for adopting a mixed methods strategy for this study. This section also shows how the research questions have been answered, including the data collection and analytical techniques applied in this study. The fourth section of this chapter covers how the research has complied with research ethics requirements, while the final section sheds light on the socio-ecological contexts of the four study settlements.

Chapter Five presents the underlying factors that drive ‘perceived vulnerability’ to climate change-related hazards in the four informal settlements in this study. The chapter which is structured into three sections presents the study’s findings on the socio-economic drivers of the vulnerability of the study respondents in the first section. This is followed by a presentation of the political and institutional drivers of the respondents’ vulnerability in the second section. Following this, the last part of the chapter presents the physical vulnerability of the respondents to perceived climate change-related hazards. Put together, this chapter shows how socio-economic, political and institutional factors, have differentially influenced the perceived vulnerability of residents of four informal settlements including climate change-related hazards in Accra.

In Chapter Six, the perceptions and knowledge of the study respondents on climate change, as influenced by their socio-economic and political contexts are examined. This chapter, which has been structured into four sections starts with the respondents’ perceptions on observed long-term environmental changes and the relation with meteorological data on Accra. In the second section, the influence of the respondents’ socio-demographic characteristics on their knowledge of climate change is analysed. Following this, the third section covers the nature of early warning on climate change received by the respondents, as influenced by their socio-political contexts. Altogether, the chapter shows how the socio-economic, political and institutional contexts of the study respondents differentially influenced their knowledge and ‘capacity to respond’ to climate change-related hazards.

Chapter Seven presents the respondents’ adaptive responses to climate change-related hazards and their contextual social vulnerabilities. It is organised into four sections. The first section examines the study respondents’ economic responses to their socio-economic vulnerabilities and climate change. The second section examines the adaptive responses of the study respondents to three major climate change-related hazards: flooding, temperature rise/excessive heat, and storms on their built environment. Following this is a discussion of the funding and support network, as well as the institutional and collective responses to climate change-related vulnerabilities in the study communities. The final section of the chapter synthesises the respondents’ structural adaptive responses to climate change-related hazards as influenced by their differentiated socio-economic and political characteristics.

Finally, Chapter Eight is the concluding chapter of the thesis. This chapter presents the findings of the study and the implications for policy-making and climate change adaptation planning practice in Accra and similar contexts. It starts by presenting the overall aim, related objectives, and research questions, to contextualise the study's findings. The second section covers the major findings and discussion of their implications for climate change research. Section three presents the implications of these findings for policy-making and climate change adaptation planning practice in Accra, Ghana. Lastly, the chapter highlights the potential areas for future research.

2 CHAPTER TWO: THE CONTEXT OF THIS STUDY

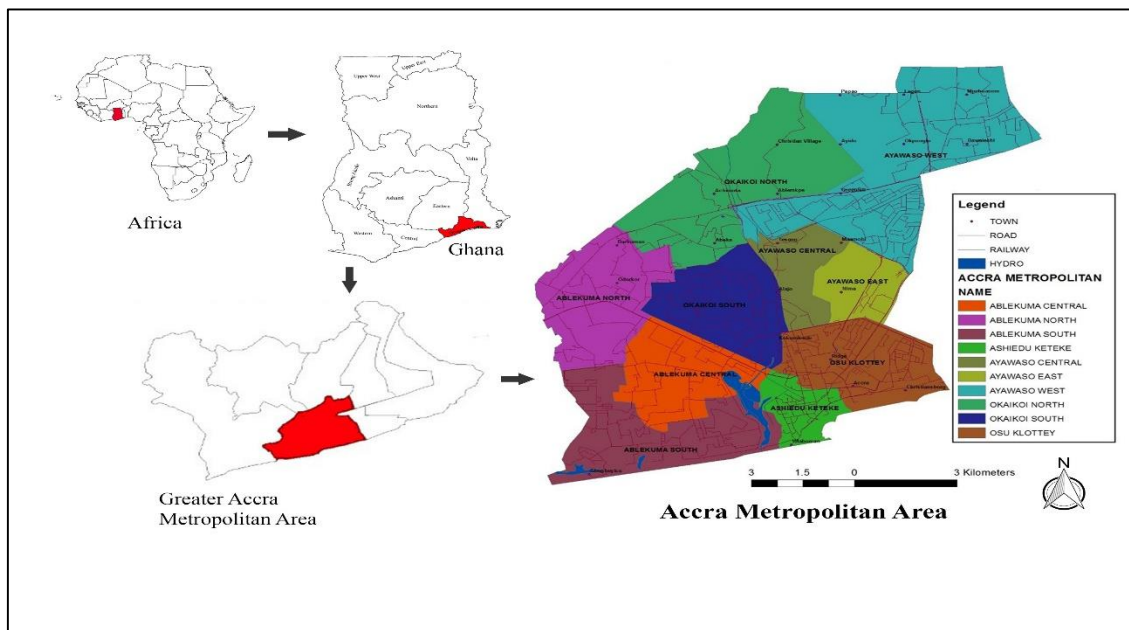
2.1 Introduction

This chapter presents the context of informal urbanisation and climate change in Accra, since “*context is king for vulnerability and adaptation to climate in cities*” (Wilbanks et al. 2007, p.15). It starts with an examination of the nature of informal urbanisation and climate change in the historical context of Accra. This is followed by the institutional and policy contexts for the governance of informal urbanisation and climate change adaptation, highlighting the policy incongruences and ramifications for residents of informal settlements. The last section of the chapter summarises the key points, making a case for a context-specific analysis of the vulnerability and adaptive responses climate change-related hazards in informal settlements in Accra.

2.2 Informal Urbanisation and Climate Change in the Historical Context of Accra

Accra is the capital city of Ghana, a lower-middle-income country located along the coast of West Africa (as shown in Figure 2.1). A reference to Accra may be to the Greater Accra Metropolitan Area (GAMA) or as contextualised in this study, the Accra Metropolitan Area (AMA) as shown in Figure 2.1. While the former is a spatially contiguous area of eight local governance jurisdictions, the latter is a local governance jurisdiction with an estimated 1.9 million inhabitants in 2017 (AMA 2014). This accounts for about half of an estimated over four million residents of the functional Greater Accra Metropolitan area (AMA 2014), which is one of the fastest-growing cities in Africa (Korah & Cobbinah 2017). Furthermore, Accra Metropolitan Area shares boundary with Ga-East and Ga-Central Municipal Assemblies to the north, Ga-South Municipality in the west, and La Dadekotopon Municipal Assembly in the east (AMA 2014). The southern boundary of AMA is the Gulf of Guinea, as Accra is a low elevated coastal city (Codjoe, Owusu & Burkett 2014).

Figure 2.1: Map of the Accra Metropolitan Area in the Contexts of Ghana and Africa



Source: Author’s construct based on maps obtained from AMA (2014).

Alone, Accra contributes an estimated over ten percent of Ghana’s Gross Domestic Product (GDP) (UN-HABITAT 2009). Related to this economic importance, it is estimated that over a million people commute in and out of the AMA jurisdiction daily to work and or access social and administrative services (AMA 2014).

Not only have informal economic activities in Accra been notably persistent, but the development of informal settlements has also been persistent (AMA 2017). Porter et al. (2011) refer to such a phenomenon as informal urbanisation, defined as the: “*modes of human settlements and trade or exchange that occur outside of formal legal structures and processes*” (p.115). Underlying this phenomenon are contextual socio-economic, political and institutional factors that influence migration and haphazard urban development (Porter et al. 2011). This is against the backdrop that over half of the estimated slum population in Ghana is found in Accra alone (MLGRD 2012).

On the other hand, Accra, like other cities in the developing world, has been affected by global climate change and variability. Currently, high-temperature values are recorded in Accra, with an average monthly temperature range of about 4°C in a year (Ofori-Sarpong & Annor 2001). Official data from Ghana Meteorological Agency also indicate rising temperatures while rainfall patterns have been increasingly erratic (MEST 2013). In addition, studies such as

Ackah et al. (2011) and Gyamfi et al. (2012) have documented evidence of groundwater salinisation, affecting the city's residents' ability to sustainably access potable water.

Furthermore, sea-levels in Accra have risen by about 2.1mm per year over the last 30 years and projected to reach 34.5cm by 2080 (MEST 2013). The rise in sea levels, coupled with gusty winds and strong waves, have been associated with coastal erosion (Appeaning Addo & Adeyemi 2013). Resulting from this, Appeaning-Addo and colleagues (2011) estimate about 0.48 km of the land of coastal communities will be lost by the middle of the current century. Therefore, an understanding of informal urbanisation and climate change in Accra will require an examination of the historical and contemporary socio-economic and political processes that have occurred in the city.

Three periods are relevant for this analysis - the period before Ghana gained political independence from British rule, the period after Ghana's political independence, and the period of economic crises and reforms. Specifically, the nature of economic activities and housing processes, which constitute informal urbanisation, are the units of analysis in this section.

2.2.1 Pre-colonial and Colonial Eras (before 1957)

2.2.1.1 Labour and Economic Activities: before 1957

The rise of informal urbanism in Accra dates back to the establishment of a formal administrative apparatus by the British colonial rulers in 1887 (Grant 2009; Oberhauser & Yeboah 2011). Prior to this, residents of precolonial Accra who mainly traded in salt and fish along the coast of West Africa did not trade much with residents of the rest of present-day Ghana (Grant & Yankson 2003b; Kea 1982). However, their contact with European traders, especially from 1887 to 1957, resulted in the trading in European goods with the rest of the Gold Coast, as Ghana was then known (Robertson 1984). In addition, before 1887, the provision of technical and clerical skills to men by the Basel Mission Society meant that men would later benefit more from formal employment with European merchants and the colonial government (Robertson 1984). The women, who were without the skills required for formal employment, mainly engaged in processing fish and petty trading in the informal economy (Agyei-Mensah & Wrigley-Asante 2014).

Subsequent development interventions led by the colonial administration served to attract migrants, expanding the informal economy of Accra. For example, the construction of a rail

line from the port of Accra to the centrally-located city of Kumasi between 1908 and 1923 created a transportation link, facilitating trade among residents of Accra and the rest of the Gold Coast, as well as for the export of cocoa to Britain (Grant & Yankson 2003b). Resulting from this and the improved socio-economic infrastructure, many migrants arrived in Accra, leading to an increase in its population by over 600 percent from 18,574 to 135,926 between 1911 and 1948 alone (Agyei-Mensah & Aikins 2010). This increase in population expanded the labour market, but as many of the migrants were without the appropriate skills for formal employment, only 48 percent of the labour force was employed by 1948. Of the employed, 68 percent were male, while 89 percent of employed females participated in vulnerable economic activities in the informal economy (Agyei-Mensah & Wrigley-Asante 2014).

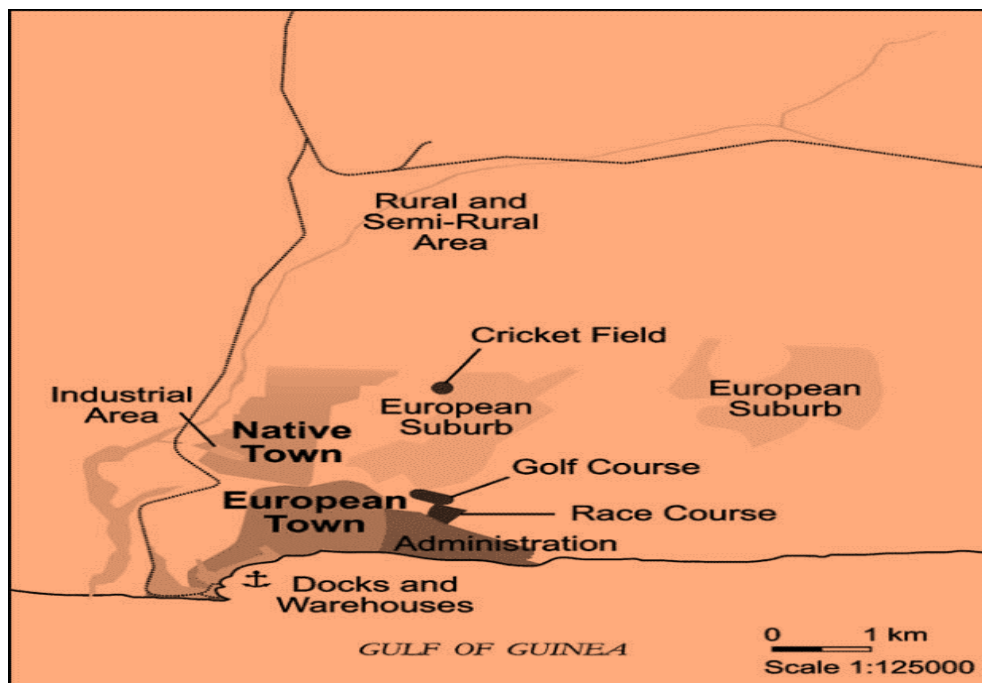
Two main processes further influenced the nature of the informal economy of Accra between 1948 and 1957. The first was a further increase in the population of Accra by about 40 percent over this period (Grant & Yankson 2003). This rapidly increasing population was accompanied by a deliberate shift in policy from governance to trading, especially the export of cocoa to Britain and the importation of industrial goods from Europe (Grant 2001; Grant & Yankson 2003b). The reduction in public sector work meant that many residents had to depend on the commodity chains that resulted from the increased commercial activity in the town. In spite of this, maintenance of the commercial centres which accommodated informal commerce was often neglected, resulting in deplorable sanitary conditions for their inhabitants (Grant 2009). The mix of insanitary conditions and climate related-hazards present a risk to residents' vulnerability to hazards.

2.2.1.2 Land Ownership and Housing Processes: before 1957

Similar to informal economic activities, the nature of informal housing can be understood from the historical land ownership and administrative processes in Accra. Land in pre-colonial Accra was owned and managed by the indigenous people. For example, a group of Portuguese traders purchased a parcel of land from traditional leaders to construct their trade post in as far back as 1482 (DeCorse 2010). However, land ownership significantly changed in the town, upon commencement of compulsory land acquisition by the state, following the relocation of the national administrative capital from Cape Coast (Henderson-Quartey 2001).

In addition to the change in Accra’s status to become the political and administrative capital of the Gold Coast, which required the development of its infrastructure, a significant reason for the redevelopment of the town was the occurrence of a devastating earthquake in 1889 (Agyei-Mensah & Wrigley-Asante 2014; Grant 2009). Grant and Yankson (2003) describe the consequent urban form of colonial Accra, as shown in Figure 2.2. This re-organisation involved creating a “European town” and the adjoining administrative and business district along the coast. Other neighbourhoods were created in the east and central north for European traders and staff of the colonial administration. Effective management of this development led to major planning legislation - the Town and Country Planning Ordinance (Cap 84) in 1945 (Larbi 1996). Thus, British zoning, building regulations, and codes were enforced in the colonial enclaves while the natives lived in the ‘native town’, separated from the more ‘formal’ colonial enclaves by a physical buffer (Grant and Yankson 2003). Similarly, the natives conducted their informal commercial activities in the ‘native town’. This was until the construction of a now prominent market centre (Makola Number 1) which accommodated the growing commerce in Accra (Grant 2009).

Figure 2.2: Spatial Form of Colonial Accra



Source: Author’s Adaptation of Grant and Yankson (2003, p.12)

Therefore, the spatial structure of Accra under colonial administration was influenced by a desire by the leaders to replicate living conditions of British cities in parts of the town.

However, new housing developed during the colonial era mainly served Europeans and British workers (Agyei-Mensah & Wrigley-Asante 2014; Weeks et al. 2007). Indeed, the 1951 Development Plan of the Gold Coast attempted to provide loans to prospective home builders (Arku 2009). However, as much as half a million pounds sterling was allocated for clearing dwellings that were owned by the indigenous residents of Accra, which were often declared as slums (Agyei-Mensah & Owusu 2010; Grant 2009).

This era which marked the ‘birth’ of British Town Planning, led to significant changes in the physical development creating a ‘grid-iron pattern’ of streets and houses in parts of Accra (Brand 1972). Agyei-Mensah and Wrigley-Asante (2014) have suggested that interventions to improve basic sanitation and environmental conditions were carried out in some native areas during this period. However, most native areas were mainly ignored and remained in poor environmental conditions (Pellow 2008; Weeks et al. 2007). Development of new neighbourhoods continued between the 1930s and early 1950s, some of which were planned while others were unplanned (Weeks et al. 2007). Nevertheless, the spatial segregation meant that migrants into Accra had to settle in the ‘native’ territory where more informal housing development evolved (Grant 2009; Pellow 2008).

A marked feature of the spatial form of Accra during this era was the location of dwellings of Europeans in the higher elevated areas (Grant 2009). It is therefore unsurprising that Weeks et al. (2007) have suggested this choice of the colonial administration to restrict the natives to low lying parts, continues to influence the latter’s exposure to flooding in Accra today.

2.2.2 Independence and Post-independence Eras (1957 to 1982)

2.2.2.1 Labour and Economic Activities:1957 to 1982

Accra's informal economy in post-independent Ghana was influenced by the economic policy of state-led industrialisation. Beyond positioning the city as an economic node, as well as the administrative and cultural centre of independent Ghana (Grant 2009; Grant & Yankson 2003), the economic policy of Ghana focused on modernisation through state-led industrialisation (Fosu & Aryeetey 2008; Grant 2009). This strategy hinged on input from the agriculture sector to share excess labour with the modern industrial economy for growth (Aryeetey 2012; Fosu & Aryeetey 2008). The preference for large-size formal state-led enterprises has been suggested by Steel (2017) to have influenced the growth in formal large-size state enterprises

while the growth of small-scale enterprises stagnated. During this period, the state of Ghana did not only facilitate but also became a prominent shareholder in over 400 industries in Accra (Grant & Yankson 2003). The over-concentration of industrial activity served to pull in migrants increasing Accra's population. The population increased from 190,000 in 1957 (Grant & Yankson 2003) to 364,719 in 1960, later by over three quarters to 617,415 by 1970 (Agyei-Mensah & Wrigley-Asante 2014) as more people arrived in search for jobs and to enjoy urban life.

This increased in-migration created surplus labour in the city (Steel 2017). The increased population, coupled with skills mismatch, reported regulatory ambiguities and inadequate formal job opportunities, created a situation where some residents who engaged in economic activities, had to operate underground of state regulations. This, therefore, added on to the prevalence of informal economic activities in the city (Steel 2017). It is this phenomenon that was observed by Hart (1973) in the 1960s among migrants in Accra when he noted a distinction between the unemployed urban poor and those who were employed outside the formal economy, leading him to coin the term 'informal economy'.

The political environment and economic policy of the late 1960s to early 1980s also influenced the evolution of the informal economy of Accra. The brief period of 1969 to 1972 was an attempt to introduce a market economy in Ghana while 1973 to 1981 was characterised by mixed attempts at import substitution and imposition of controls on the economy (Fosu & Aryeetey 2008). This period also saw attempts at economic recovery following declining industrial production and general economy (Aryeetey & Fosu 2002; Fosu & Aryeetey 2008). In terms of population, the period corresponded with relatively slow population growth from 617,415 in 1970 to 956,157 in 1984 at 3.1 percent compared to 5.1 percent in the previous decade (Agyei-Mensah & Wrigley-Asante 2014).

Although there is no Accra specific data, three forms of increasing informalisation during this period can be inferred from the national trends for Accra, as analysed by Steel (2017). The first was an informal private sector choosing to avoid controls and regulations by operating in the underground economy. The second was informal work, including self-employment as the main source of livelihood led by women as the formal sector stagnated and resulted in losses in formal wage employment (Steel 2017). The third was mostly men in the formal sector,

engaging in supplementary informal work (Steel 2017). Thus, historical political and economic factors together influenced the nature of the informal economy in Accra from 1957 to 1982.

2.2.2.2 Land Ownership and Housing Processes:1957 to 1982

Similar to the increased role of the state in the economic processes, an increase in the state's involvement in land acquisition and management processes, also influenced land ownership and housing development in Accra. For instance, by introducing the Administration of Lands Act 1962 (Act 123) and State Lands Act 1962 (Act 125), the state empowered itself to compulsorily acquire land from the indigenous people (Larbi, Antwi & Olomolaiye 2004). A related land management legislation that caused controversy and continued to influence the informal development processes in Accra was the Land Development (Protection) of Purchaser Act, 1960 (Act 2). This law protected and conferred ownership rights on developers who constructed their properties up to significant levels even if they did not have formal titles to the land (Ayee & Ayee 2011). By so doing, the state indirectly influenced the property rights regime in Accra and inadvertently influenced encroachment on lands by those with resources. Resulting from these processes, land ownership, and usage arrangements in Accra have included customary ownership, private ownership, state ownership, and informal arrangements (Larbi 1996). This mix of land ownership and related land-use practices continue to influence housing development in Accra today.

The post-independent Ghanaian state improved housing in Accra by encouraging development away from the coast and central business district. Although there were high nationalistic interventions to project a unique Ghanaian identity, new legislation enacted was modelled mainly along with the colonial development regulatory framework. For instance, while more relaxed zoning policies were adopted to allow for mixed residential and commercial land uses (Grant 2009), enactment of the Town and Country Planning Act, 1958 and Town and Country Planning Regulations (1959) was inspired by the colonial planning legislation (Boamah, Gyimah & Nelson 2012). Guided by the new regulations, the managers of Accra constructed more market centres for the increasing informal commerce in other parts of the city (Grant & Yankson 2003). This spatial reorganisation of Accra was further influenced by the construction of a new port in Tema, a city located at about 25 kilometres in the east of Accra in 1962, with Accra then shedding its function as the port city (Grant 2009).

In terms of housing processes, housing construction was state-led through the State Housing Corporation during this period (Grant & Yankson 2003). Together with the Tema Development Corporation (TDC) which had the mandate to develop the port town of Tema, the implementation of this policy marked the emergence of the formal housing market (Agyei-Mensah & Wrigley-Asante 2014). By 1971, more than half of the over 6000 housing units constructed by the State Housing Corporation were in Accra (Tipple 2000). The rapid population increase in the 1960s, however, meant that housing became inadequate in the city (Brand 1972). Later efforts to increase housing development, especially under the military regime led by General Acheampong included the construction of the Dansoman neighbourhood (Agyei-Mensah & Wrigley-Asante 2014). However, the general decline in the Ghanaian economy between the late 1960s and 1980s, affected all sectors, including housing development, creating housing shortages even at much lower immigration into Accra (Agyei-Mensah & Wrigley-Asante 2014). In summary, this section shows that the nature of informal urbanisation during the period after Ghana's political independence was determined by a suite of political and economic processes, as well as evolving institutions.

2.2.3 Structural and Post-structural Adjustments Eras (1983 to 2000s)

2.2.3.1 Labour and Economic Activities: 1983 to 2000s

The adoption of economic recovery programmes referred to as Structural Adjustments Programme (SAP) (1983 to 1990s) has often been cited as the period for the consolidation of the informal economy in Accra (Obeng-Odoom 2011c; Yeboah 2003). The economic reforms under the supervision of the World Bank and International Monetary Fund (IMF), which sought to stabilise and transform the economy included trade liberalisation, deregulation of sectors of the economy and a reduction in government expenditure (Aryeetey & Fosu 2003; Yeboah 2010). A primary mechanism for carrying out this was the privatisation of state-owned enterprises, including utilities for the provision of water and sanitation, and cuts in public sector employment (Aryeetey & Fosu 2003; Yeboah 2010). For example, an estimated 280,000 public sector jobs, representing 60 percent of the total formal sector workers were lost over the period 1985 to 1991 alone (Gockel 1998). While the overall macro-economy of Ghana improved during the period of economic reforms (Aryeetey, Harrigan & Nissanke 2000), micro-level impacts of the adjustments meant that some households needed to diversify and engage in alternative livelihoods activities (Steel 2017).

In contrast to a decline in formal sector jobs, Accra's population grew at 4.1 percent from 969,000 in 1984 to 1,513,000 by 1995 and further by four (4) percent to 1,843,000 in 2000 (Maxwell et al. 2000). The migration of mainly young people from other parts of Ghana to Accra further expanded the labour market that only offered limited formal wage employment opportunities (Baah-Boateng 2013). In addition to the loss of jobs to men, this increased men's participation in informal economic activities in Accra (Konadu-Agyemang 2000; Overå 2007).

The period from 2000 up to the present, referred to as the 'golden age of businesses' has been marked by economic growth and periodic crises in the national economy. This has resulted in the intermittent engagement of the IMF to assist in stabilising the national economy (Steel 2017). Furthermore, the increased focus on the private sector as 'the engine of growth' in this period has consolidated some of the gains made in the economy from the 1980s (Steel 2017). Also significant during this period is an increase in foreign participation in the Ghanaian economy as Accra becomes increasingly connected with the global economy (Grant 2009). The resultant increasing need for land for commercial development has served to further influence the enforcement of land usage rights by the state authorities, often accompanied by forced eviction of traders and squatters (Afenah 2009a). It is these evictions that have negatively affected residents' ability to mobilise assets and to protecting them from climate-related hazards such as flooding.

During this period, however, while the share of formal employment in the economy has been on the decline, that of employment in the informal economy has been on the rise. The national share of employment in the formal economy reduced from 16 percent to 12 percent between 1984 and 2013, while the share of informal employment increased from 84 percent to 88 percent in 2013 (Baah-Boateng 2017). In relation to the sectors of employment, although there has been increased foreign participation in the Ghanaian economy, relatively lower growth of the manufacturing sector compared to the faster-growing service-commerce sector has also resulted in significant informal commerce in Accra (Steel 2017). As shown in Table 2.1, according to Ghana Statistics Service (GSS 2014), 74 percent of Accra Metropolitan Assembly area's labour force was engaged in informal economic activities in 2010 compared to about only 60 percent as reported by Grant and Yankson (2003) in 2000.

Table 2.1: Employed Population 15 Years and Older in the Accra Metropolitan Area

Employment Sector	Both Sexes		Male		Female	
	Number	Percent	Number	Percent	Number	Percent
Total	772877	100	378489	100	394388	100
Public (Government)	60483	7.8	37157	9.8	23326	5.9
Private Formal	130302	16.9	89380	23.6	40922	10.4
Private Informal	571793	74	244726	64.7	327067	82.9
Semi-Public/Parastatal	1231	0.2	834	0.2	397	0.1
Non-governmental organisations	7749	1	5473	1.4	2276	0.6
Other International Organisations	1319	0.2	919	0.2	400	0.1

Source: GSS (2014)

The period of 1983 onwards marked the expansion and consolidation of informal commerce, including head-portage and street hawking in Accra (Overå 2007). As women were the early entrants, the majority (57 percent) of workers in Accra's informal economy is therefore female, while less than half (43 percent) are male (GSS 2013).

Many researchers on Accra such as Grant (2009), Obeng-Odoom (2011) and Yeboah (2010) have associated this persistence of the informal economy (land markets inclusive) with the economic reforms of 1983. For instance, Yeboah (2010) contends that the persistence of the informal economy is attributed to cuts in public sector employment. This is said to combine with the increasing focus on the private sector with limited pro-poor policy interventions which influenced rural-urban migration to Accra (Yeboah 2010). For Obeng-Odoom (2011), it is also important to note the profit motivations of the private sector, and the related socio-economic inequalities as well as possible forms of exploitation of informal workers in this period. Steel (2017), however, points to limited evidence to support the relationship between increasing informal enterprises and their subordination to formal industrial enterprises. He observes that the general proportion of formal industrial sector activity in Ghana declined during this period of increasing 'informalisation' (Steel 2017). Moreover, to Steel (2017), the evidence of this is shown in the fact that most new entrants into the labour market since 2000 have been in informal self-employment, rather than working as exploited employees (Steel 2017). Nevertheless, the present dominance of informal commerce in Accra raises questions about the

possible forms of exploitative practices and vulnerabilities that may occur between informal workers and the ‘more formal’ distributors (Anyidoho 2013).

Another significant part of the economic reforms with a potential economic impact on residents of informal settlements is the ramification of financial deregulations carried out during this period. For instance, it has been argued that the deregulation of the financial services sub-sector in Ghana has created a burgeoning market for financial services (Aryeetey-Nanor 2008; Aryeetey & Baah-Boateng 2016). Nevertheless, the requirement of collateral by formal financial services has mainly accounted for the residents having to mainly rely on informal financial sources (Anyidoho 2013). It has therefore further been argued that the increased supply of financial services during this era has been exclusionary of the urban poor due to the strict borrower eligibility requirements of credit providers (Aryeetey 1992; Steel et al. 1997). Limited access to credit has the potential to render informal settlements’ residents economically vulnerable and to climate-related hazards such as excessive heat and flooding.

2.2.3.2 Land Ownership and Housing Processes:1983 to 2000s

As with economic activities, changes in land management and dwelling processes since the period of economic reforms have influenced the process of informal urbanisation in Accra. The Ghanaian 1992 Constitution, which is a product of the democratic reforms, recognises [in Article 257] the prevalent dual customary and formal land management structures in Ghana. In this, an estimated 80 percent of land in Ghana (Kasanga & Kotey 2001), and about 89 percent in Accra is under customary land ownership (Grant and Yankson 2003). Under customary land ownership system, land belongs to kinship groups consisting of ancestors, the living and future generations. Therefore clan and family heads, as well as chiefs, do hold land in trust of their kinship groups (Kasanga & Kotey 2001). This implies that, even though the Stool Lands Secretariat is mandated to oversee customary land transactions, present land administration in Ghana comprises a parallel system of the state on the one hand, and traditional authorities and families on the other (Kasanga & Kotey 2001).

Added to the dual land management structure is the cumbersome development permission regulatory regime in Ghana. Ghanaian legislation such as the Local Governance Act, 2016 (Act 936) and the Land Use and Spatial Planning Act, 2016 (Act 925) together empower state institutions to determine the use of land through enforcing zoning and building regulations, in

public interest. Together with the National Building Regulations (L.I.1630, 1992) and National Building Code (2012), the state has therefore provided elaborate requirements for development control. The National Building Regulations (L.I.1630, 1992) require prospective developers to acquire permits for new development or modification to old structures, with regular inspections of the development from commencement to its completion. These requirements include the presence of a formal land title, conformity with specific land sizes with detailed drawings as well as prescribed material to be used for the development. Also, the development must comply with local zoning plans, which tend to be non-existent for many parts of the city (Grant and Yankson 2003). The prescriptive development standards within a dual land management process have continued to influence informal development processes in Accra today. Resulting from this regulatory framework and its enforcement is an estimated 76 percent of development on customary land in the city uncovered by formal building permits (Kasanga & Kotey 2001).

A further challenge of the nature of informal housing can be understood in the context of the high cost of formal sector housing, given the present lack of direct state intervention in providing adequate and affordable housing in Accra. For instance, the most significant and comprehensive spatial planning intervention on Accra during the period of the economic reforms was the Greater Accra Metropolitan Area (GAMA) Strategic Plan (UNDP & UNHABITAT 1992). This plan, which was not fully implemented, was intended to be executed through private sector investments. Nevertheless, with increased private sector participation in the housing market, it has been found that only about 17.5 percent of residents of Accra can afford the cheapest formal sector housing produced (Awanyo, McCarron & Morgan Attua 2016). Added to the high cost of housing is the non-responsiveness of the housing mortgage market as products are mainly available to people with formal employment and sources of income (Acheampong & Anokye 2015). Resulting from the high cost of formal sector housing and cumbersome development permission processes is an estimated 90 percent of the housing stock in Accra being produced by individuals on an incremental basis (Arku 2009; Gough & Yankson 2011a). The limited enforcement of building standards often leads to poor quality development of such houses in informal settlements (Arku 2009) making them potentially susceptible to climate-related hazards such as floods.

Resulting from this, although the exact number of people living in informal settlements in the Accra Metropolitan Area is highly contested, Grant and Nijman, (2004) estimate about 60

percent of the city's population reside in informal settlements. Jankowska, Weeks and Engstrom (2011), however, estimate that only six (6) percent of housing in Accra Metropolis are without slum characteristics. Available data from Ghana Statistics Service (GSS 2014) further offers insights on the housing situation in AMA. In 2010, the population of 1,665,086 in AMA lived in 149,689 housing units, shared by 450,794 households. With about 11 persons per house and more than a quarter (42.1 percent) of households renting, housing ownership is lower only at 36.5 percent. Also, about 13.1 percent of the residents of Accra lived in dwellings owned by relatives while the rest (8.3 percent) lived in houses belonging to their employers or other private agency (GSS 2014).

Furthermore, even though the state owns about 13 percent of the total land area in Accra (Larbi, Antwi & Olomolaiye 2004), only 4.1 percent of residents of AMA lived in government-owned housing (GSS 2014). This can be understood against the backdrop of the state's limited role in housing production since the period of economic reforms. Thus, with an average household size of 3.7, about two-thirds (65.0 percent) of households in the metropolis occupy only one sleeping room (GSS 2014). According to the AMA (2014), addressing the present congestion situation requires the construction of an estimated 300,000 dwelling units in the metropolis. This situation explains why many migrants into Accra may settle in informal settlements where rent levels and housing quality are relatively lower (GSS 2014). Living in informal settlements expose residents to climate-related hazards such as flooding and fire outbreaks to mention but a few.

Another aspect of the housing conditions in Accra is the poor quality of housing in informal settlements. Although housing in newly expanding gated communities is built to modern standards (Asiedu & Arku 2009; Grant 2009), significant levels of housing conditions in Accra remain poor. According to the Ghana Statistics Service (2014), while 82 percent of dwellings in AMA use blocks and concrete, about 11 percent use wood for constructing their walls. Another seven (7) percent of housing in AMA, however, use improvised material including slates and roofing sheets for constructing walls (GSS 2014). The mix of material used for constructing floors of dwellings is similar to that of material used for constructing walls, while the material used for roofing is mainly (92.2 percent) of metal sheets and slate/asbestos (GSS 2014). Together, the data shows the poverty of housing conditions in which about 7.1 percent of housing in the city is constructed with improvised materials, especially in informal

settlements (GSS 2014). As such, dwellings in informal settlements in Accra are mostly unsuitable to withstand climate change-related hazards such as flooding and water-logging (Amoako 2014).

Added to the poverty of housing conditions is the ramification of the reduced role of the state in the provision of public services since the economic reforms. According to Ghana Statistics Services (2014), while 31.8 percent of the dwellings in AMA access in-house pipe-borne water for drinking, more than a quarter (28.3 percent) use sachet-packaged water. Of the total, over a quarter use pipe-borne water outside of their dwellings (GSS 2014) while close to a tenth (9.1 percent) of the residents still, do not have access to a toilet facility. Access to waste collection services is also according to the spatially and economically segregated nature of the city (Grant 2009). As a result, while residents of the more 'formal' part of the city have their waste frequently removed through private contractors, more than a quarter (32.9 percent) dump their waste into public containers for onward disposal (GSS 2014). The economically disadvantaged residents, in informal settlements, dispose of their waste in several ways, including throwing it in the open and/or drainage network (AMA & UN-HABITAT 2009). By clogging the often few drains, informal settlements' residents become exposed to climate-related hazards of flooding, excessive heat and storms to mention but a few (AMA & UN-HABITAT 2009).

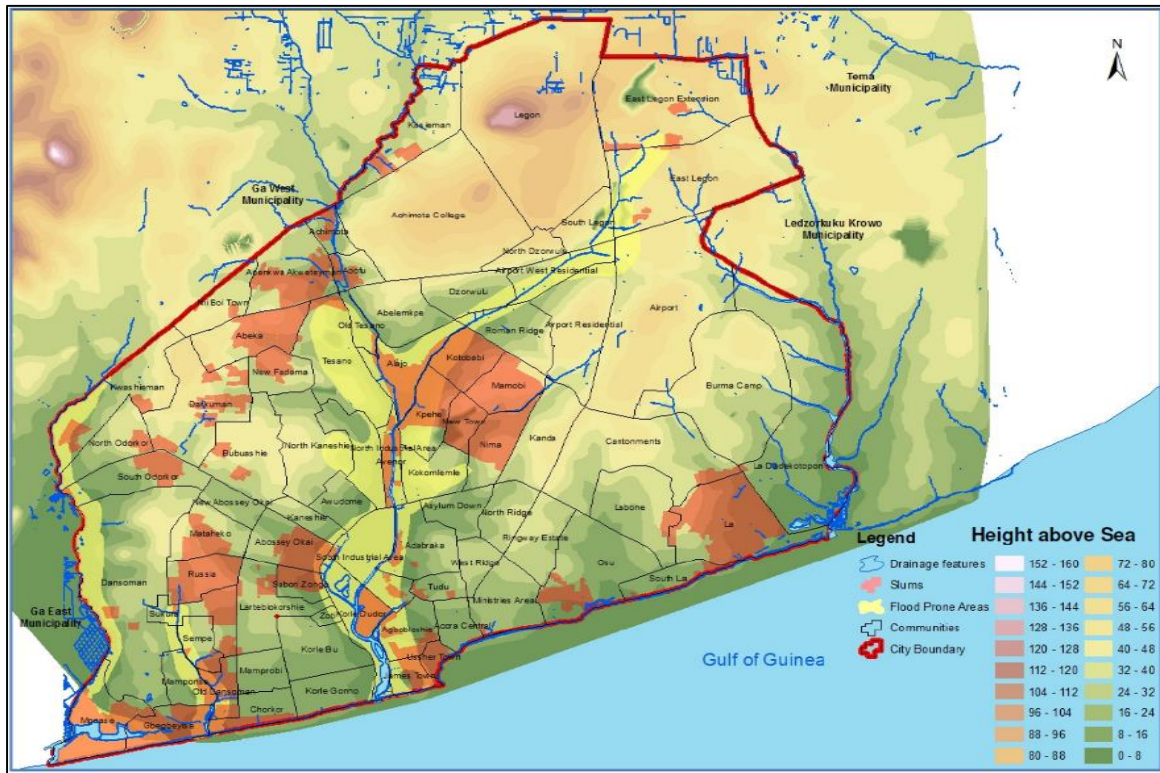
By its location, where most parts are below 40 meters at sea level, many communities in Accra are susceptible to flooding (Figure 2.1) (AMA & UN-HABITAT 2011). Flooding in Accra appears to be a more recurrent phenomenon in recent times, since its most notable occurrence in 1963 (Ahadzie & Proverbs 2011). More than a hundred thousand people were rendered homeless and 12 people dead in June 2001 (Karley 2009) while floods that occurred in October 2011 displaced approximately 17,000 with about 14 dead (UNEP & OCHA 2011). A higher estimated 5188 people were affected, 22 people died, and six (6) injured in 2010 from flooding related events in the Greater Accra Region, including Accra Metropolis. A further 6,888 people were affected in 2012, while much higher 16,806 people were affected and five (5) dead in 2014 (UNEP & OCHA 2011). The effects of flooding in 2015 were more severe when 30,688 people in the region were displaced, and 135 people died in Accra Metropolis alone (Appiah 2015).

The increasing intensity of flood-related events has also been associated with the nature of the drainage network of the city (Amoako & Frimpong Boamah 2015). The natural drainage of Accra comprises three river catchments and lagoons - Densu River and catchment area, Sakomo Lagoon and Odaw River catchment, and Korle Lagoon and Kpeshie, which connect into the Gulf of Guinea (Abbey 2013; Nyarko 2002). Moreover, as parts of Accra are below sea level, over half of the 82 demarcated communities are exposed to flood risks (AMA and UN-HABITAT 2011). It is therefore not surprising that about three-quarters of informal settlements are located along the Odaw-Korle and Chemu catchment area (shown in Figure 2.1) often comparatively heavily suffer from flooding in recent years (Amoako & Frimpong Boamah 2015).

Recognising the informality and climate change challenge, the city authorities in Accra, have mapped out all the 82 settlements/communities in their jurisdiction. By categorising them according to tenure security and access to essential urban services of sanitation and water (Figure 2.1) (AMA & UN-HABITAT 2011), the city appears to view residents of the various communities relative to their land tenure arrangement.

In summary, this section of the chapter shows that historical and contemporary socio-economic and political processes are associated with the marginalisation of residents of informal settlements. This marginalisation, in turn, influenced informal dwellers' location in hazardous places, unevenly exposing them to climate change-related hazards in Accra. The above situation makes the vulnerability of residents of informal settlements in Accra, worthy of investigation.

Figure 2.3: Areas Exposed to Flood Risks and Location of Informal Settlements in Accra



Source: AMA & UN-HABITAT (2011 p.10).

2.3 Politics and Governance of Urban Informality and Climate Change in Ghana

This section of the chapter is an examination of the governance arrangements and related policies for managing informal urbanisation and climate change in Accra. It begins with the governance and institutional structures for managing urban development, followed by related policies. This is followed by a presentation of the institutional context of climate change and related policies, highlighting gaps in policies and their incongruences for managing the combined challenge of informal urbanisation and climate change.

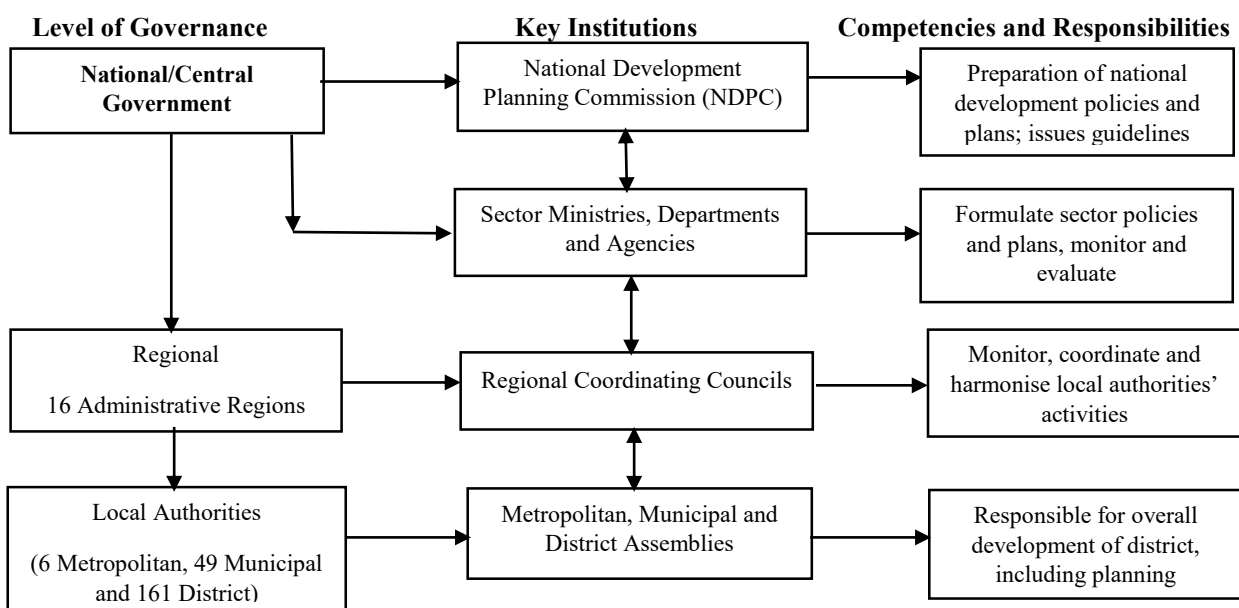
2.3.1 Governance Structure and Institutions for Urban Development in Ghana

Governance reforms embarked upon in Ghana since the period of economic reforms involved setting up of the political and administrative structures for urban governance (Acheampong & Ibrahim 2016). Legislation on local governance in Ghana is based on the local governance system established by the Local Governance Act (Act 462) of the 1992 Ghanaian constitution. This legislation provides an elaborate and hierarchical structure for political and administrative governance in Ghana, as shown in Figure 2.4.

Politically, Ghana operates a unitary democracy (as opposed to a federal state, such as Australia), administered through three arms; namely the Executive, the Legislature and the Judiciary. As the leader of the Executive arm, the President of Ghana is elected by a popular majority once every four years. Similarly, members of the Legislature are elected every four years. Together, the Executive, Legislature and Judiciary, constitute the functional Ghanaian State at the national level (Owusu 2015).

Administratively and for development policy coordination, the central government of the Ghanaian State comprises national ministries, in addition to the National Development Planning Commission (the hierarchy is shown in Figure 2.4). As part of the local governance structure, the National Development Planning Commission is charged with the responsibility for advising the President of Ghana on national development. National ministries are responsible for policy formulation, implemented through their departments and agencies. Below the national/central government are sixteen administrative regions. The Greater Accra Region, to which Accra is the capital city, is one of the sixteen administrative regions of Ghana.

Figure 2.4: Ghana’s Local Governance and Institutional Structure



Source: Author’s adaptation of Ibrahim and Acheampong (2016, p.10)

Next lower governance entity to the region is the Local Authority, which may be termed a Metropolitan Assembly or Municipal Assembly or District Assembly depending on its corresponding population threshold. Metropolitan Assemblies comprise jurisdictions of a minimum of 250,000 residents, while Municipal Assemblies comprise jurisdictions of a

minimum of 95,000 but not up to 250,000 residents. The lowest of the three, a District Assembly is an area with a population of a minimum of 75,000 but not up to 95,000 residents (Ibrahim and Acheampong 2016). Accra, with over 1.9 million residents, is a Metropolitan Assembly, thus the Accra Metropolitan Assembly (AMA).

According to the Local Governance Act (Act 462 1993), the General Assembly of the Local Authority of Accra, headed by its Presiding Member (the speaker) is the highest body which approves the appointment of the Chief Executive. The Chief Executive who is mandatorily nominated by the President of Ghana is the political head of the Accra Local Authority. Furthermore, consistent with the Local Governance Act, the General Assembly is comprised of mainly elected local councillors, but a third of them are also appointed by the President of Ghana. Moreover, under the Local Governance Act, the Accra Metropolitan Assembly is the local level legislative, rating and development authority for Accra. Therefore, according to legislation [Section 46 of the Local Government Act, 1993 (Act 462)], the Local Authority (AMA) is required to deliver municipal services and drainage infrastructure for managing climate change-related hazards such as flooding.

To perform this development function, the AMA has been divided into ten (10) Sub-Metropolitan District Councils (AMA 2014) also shown in Figure 2.1. By their functions, the Sub-Metropolitan District Councils, are the lower-level state governance units responsible for development control, environmental cleanliness and community development (Botchwey 2017). In addition, while administrative work in a Sub-Metropolitan Council is led by a civil servant administrator, its overall leader is the chairperson, who is either one of the elected councillors or an appointed politician (Owusu 2015). Parallel to this elaborate governance structure is a multi-party constitutional arrangement for the conduct of competitive elections at both sub-national and national levels (Crawford 2009). It is within these arrangements that local councillors and members of the Ghanaian Parliament are elected once every four years. Resulting from this is the architecture for planning and approving service provision such as drainage infrastructure for responding to climate change-related hazards in informal settlements (Grant 2006; Paller 2012).

2.3.2 Urban Policies and Urban Informality

2.3.2.1 Policies on Informal Economic Activity

Generally, the policy framework and interventions on the informal economy in Accra remain varied and fragmented. In terms of policies, while the Ghanaian national government has produced a draft national strategy since 2012 intended to guide the coordination and optimisation of the benefits of the informal economy (MEL 2012), the policy activities remain inconsistent with policy provisions in Accra Metropolitan Area and Ghana. For instance, the Labour Law (Act 651, 2003) requires all employees to obtain formal employment agreements, in order to qualify for formal employment benefits including contribution towards a pension scheme, paid leave and workplace safety. However, enforcement of these requirements has excluded informal workers due to the absence of documentation (Anyidoho 2013).

Another state policy intervention related to the informal economy is the introduction of a pension scheme for informal sector workers through the Social Security and National Insurance Trust (SSNIT) (Osei-Boateng & Ampratwum 2011). Although an important policy intervention, the associated institutional bottlenecks in the formal sector have rendered this service out of the reach of many workers of the informal economy increasing their vulnerability conditions (Osei-Boateng & Ampratwum 2011).

Provision of health insurance is another main policy intervention by the Government of Ghana to meet the health needs of informal sector workers. Through the National Health Insurance Scheme in Ghana, informal workers can make payments of health insurance premiums in order to access needed health care. However, the requirement for documentation at enrolment has also been found to place this policy out of the reach of many informal workers making them vulnerable to ailments (Gajate-Garrido & Owusua 2013) and climate-related hazards.

Added to this is the Livelihood Empowerment Against Poverty (LEAP) Programme, which has been introduced as a social intervention to support the livelihood activities of the extremely poor. However, a study found that the selection of beneficiaries of this programme has been limited to specific locations and often subjected to political interference, thereby not reaching the most marginalised populations at all times (Thorne et al. 2014). Indeed, interviews conducted in Accra revealed that the selection of project beneficiary communities for LEAP is

largely influenced by the nature of land ownership of a community/settlement. This was referred to by a staff of AMA who noted that:

Our target communities are presently six communities. Although we are extending, we do not intend to include Old Fadama to the list. It was during the elections that there was pressure for us to extend it there, but we could not do it. Generally, we do not extend this to squatters (Interview #I16).

Another major area of policy challenge is the taxation of informal workers. The introduction of informal sector tax rate, at the national level, seeks to mobilise revenues for the state while informal workers also pay for business operating licenses as well as market tolls/rates to local Authorities (Anyidoho 2013). A study by Andoh (2017), shows the recent challenges associated with the Ghanaian state's efforts to mobilise this revenue from the informal sector, which include concerns about the confusing roles of the related tax institutions among informal traders. Despite this recognised importance of informal workers, they continue to suffer from evictions, especially after a bye-law was passed in 2011 by the AMA which was aimed to 'decongest' the city (Anyidoho 2013). The 'decongestion' activities by the local authorities (AMA) are part of efforts to project Accra as a modern city (Gillespie 2016a; Obeng-Odoom 2011a).

The overall view of this section is two-fold. Firstly, there have been policy interventions to respond to some challenges faced by workers of the informal economy in Accra making them potentially more economically vulnerable. However, challenges of policy incoherence and implementation gaps continue to affect the environmental conditions of informal workers, including their capacity to respond to climate-related hazards in Accra.

2.3.2.2 Policies on Informal Settlements

The Ghanaian State's recognition of the informal settlements' challenges, at both the national and local levels of governance, can be seen in the relevant policies and strategies that have been prepared by the Government of Ghana. In terms of the recognition of informal settlements, the National Urban Policy Framework and Action Plan for the Urban Policy (MLGRD 2012a, 2012b), National Housing Policy (MWRWH 2015) and Ghana Shared Growth and Development Agenda 2014-2017 (NDPC 2014) recognise and propose interventions to respond to urban growth, including upgrading, relocating and preventing the development of informal settlements. For instance, the Housing Policy includes proposals to set-up a mortgage

fund for funding upgrading activities in informal settlements but lacks a clear strategy for doing so.

The second policy challenge on informal settlements relates to the contradictory framings of these settlements' legality and the inadequacy of the policy thrusts. According to the Ghana Urban Policy Framework, informal settlements are communities that are characterised by "*illegal occupation or have been developed in an unauthorised fashion*" (MLGRD 2012a, p.14). Similarly, the Ghana Shared Growth and Development Agenda (2014-2017) defines these settlements as "illegal" or "irregular" communities and has sought to prevent this 'illegality' from being perpetuated (NDPC 2014 p.16). Meanwhile, earlier policy document of Ghana Poverty Reduction Strategy present "*housing provision as a strategic area for stimulating economic growth*", while only vaguely referring to the need for preventing the development of informal settlements (NDPC 2005, p. 25). In contrast, the second Poverty Reduction Strategy of Ghana (GPRS II), is quite progressive as it proposes to: "*improve the infrastructure facilities in slum areas and restrict the formation of new slums*" (NDPC 2005, p.12). However, both policy documents do not critically examine why informal settlements arose in Ghanaian cities in the first place.

Furthermore, a common challenge of these policy frameworks has been a lack of implementation of their content. Owusu and Yankson (2017) have summarised the myriad of factors that account for this lack of implementation of urban policies. These include policy incoherence among different policy provisions and duplication of institutional mandates that are tasked with the responsibility for policy implementation. Other major challenges found by Owusu and Yankson (2017) are the coordination of the relevant actors as well as competing needs for funding among the different levels of state agencies that are often involved. This was evident for the Draft National Slum Upgrading Strategy which has been prepared since 2015 but yet to be finalised for possible implementation as at 2017 [*based on field interviews in July 2017*].

A recent state policy response is the setting-up of a National Ministry for 'Inner Cities and Zongo Development' in Ghana. This ministry has the sole mandate to improve the living conditions of residents of informal settlements. Therefore, with the passing of the Act of parliament for the Zongo Development Fund, (Act 921) (2017), it may be argued that the

institutional and policy environment of Ghana presents new prospects to potentially improve living conditions of some informal settlements in Accra. However, this relatively new ministry also faces the challenge of effectively coordinating its activities with the related agencies, as was mentioned in interviews with almost all state institutions during the fieldwork in June 2017.

2.3.3 Climate Change Institutional and Governance Structures

Ghana's active engagement with climate change-related issues at the global level has led to current commitments aimed at mainstreaming climate change into its national development agenda. For instance, Ghana signed on to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (Cameron 2011). Resulting from this, the country has been participating in the Conference of Parties (COP) for years (Cameron 2011).

Efforts to mainstream climate change into its national development agenda in Ghana have included the setting up of the Ministry of Environment, Science and Technology (MEST), intended to coordinate environmental policy formulation, monitoring and evaluation after implementation (Cameron 2011). Within MEST is the National Committee on Climate Change (NCCC), a multi-stakeholder committee of Ministries, Departments and Agencies (MDAs), as well as Donors, Civil Society Organisations (CSOs), research institutions and the private sector (Cameron 2011). Their mandate is to review government policies and programmes to ensure complementarity both for adaptation to climate change and mitigating greenhouse gas emissions (Cameron 2011).

As the technical wing of MEST, the Environmental Protection Agency (EPA) is established by law to regulate and enforce the policy provisions by MEST and is responsible for coordinating the technical activities related to climate change (MEST 2013). The EPA performs this function through its Climate Change Unit. In addition, the EPA is responsible for coordinating climate change adaptation activities, including managing activities related to the Adaptation Fund as well as preparation of the National Communications to the United Nations' Framework Convention on Climate Change (UNFCCC) (Tutu & Nelson 2012).

Furthermore, the national architecture for managing climate change policy and implementation also includes the Ministry of Finance and Economic Planning (MoFEP), the national ministry responsible for economic planning and budgeting in Ghana. This ministry is responsible for managing resources for climate change, including funds from the Adaptation Fund (MEST

2013). To further ensure mainstreaming of climate change into the national development agenda, the National Development Planning Commission (NDPC), has been mandated to prepare and ensure effective implementation of approved national development plans and strategies that incorporate climate change adaptation (MEST 2013).

The network of national actors has worked to integrate guidelines for mainstreaming climate change issues into national planning guidelines for the preparation of the Medium-Term Development Plans (MTDPs). By this, the Local Authorities are mandated to include climate change adaptation in their planning (MEST 2013). Therefore, the Accra Metropolitan Assembly is required to adopt participatory planning processes to prepare and implement Medium Term Development Plans (MTDPs), using funds from the consolidated fund, as well as internally generated revenues (Tutu & Nelson 2012).

There are other related actors, including the Ghana Meteorological Agency (GMA), the agency responsible for generating weather information, and monitoring climate change in Ghana. Also important in this arrangement is the Ministry of Local Government and Rural Development, the ministry with the responsibility for all local authorities. Moreover, ministries such as Ministry of Water Resources, Works and Housing; Ministry of Education; Ministry of Gender, Children and Social Protection; as well as Non-Governmental/Civil Society Organisations and the private sector are identified as important agencies with the responsibility for mainstreaming climate change issues into national policy and development agenda (MEST 2013). Furthermore, the efforts to mainstream climate change into national systems have led to staffing state institutions with Climate Change Officers [*based on interviews in July 2017*]. Overall, however, while this institutional architecture seems elaborate, it also highlights challenges of clear delineation of responsibilities and the coordination of climate change issues in Ghana.

2.3.4 Climate Change-related Policies and Strategies

Resulting from the work of the actors in climate change governance in Ghana are related policies, strategies and interventions, such as the current globally mandated National Communications on Climate Change. Key policy frameworks also include the national Climate Change Policy as well as the National Climate Change Adaptation Strategy (NCCAS). In addition, climate change issues have been integrated into the national development strategy document referred to as the Ghana Shared Growth and Development Agenda (GSGDA).

Moreover, the National Climate Change Policy, spells out the national priority for climate change mitigation, stating the priority sectors and the need for adaptation through mainstreaming of climate-related issues into all sectors of the country's development (MEST 2013).

However, a more explicit Ghanaian state's position on adaptation is articulated in the National Climate Change Adaptation Strategy (NCCAS) (MEST 2010). The preparation of this strategy, which commenced in 2006 ended in 2010 with a duration of up to 2020 (MEST 2013). This strategy aims to increase the resilience of vulnerable groups and protect their property. Therefore, together with the Climate Change Policy, the Ghanaian government has demonstrated its recognition of the ramifications of climate change on vulnerable populations and the need to respond to these vulnerabilities. However, the extent to which this has been done in the context of Accra remains to be examined, further justifying an examination of the vulnerability and adaptive responses of residents of informal settlements to climate change in the city.

Other climate change-related policies include the National Disaster Prevention and Mitigation Plan (NADMO & UNDP 2010) which is focused on disaster risks prevention, and setting-up early warning systems for hazards. An examination of this strategy document shows a lack of specific attention to informal settlements' residents. Related to this finding is that while the National Water Policy (MWRWH 2007) also calls for the integration of water resources planning with land use planning, as well as protection of coastal zone and wetlands from human activity, it overlooks the needs of informal settlements' residents. Similarly, the Riparian Buffer Policy (WRC 2008) which guides how buffer zones are to be created and managed along water bodies, has only been explicit on the protocols for monitoring and enforcing the guidelines. Nevertheless, these guidelines have only addressed the ways to prevent and remove encroachment, including informal developments, on riparian buffer zones similar to the policy frameworks as shown in Table 2.2.

Table 2.2: Synthesis of Main Policy Frameworks, Strategies, Focal Areas and Implementation Action Planning

N	Main Policy Frameworks/Interventions	Sector			Has a specific theme/focus on informal residents/workers?		Has an active policy action plan for coherent implementation?	
		Economic Activity	Dwelling Processes	Climate Change	Yes	No	Yes	No
1	National Strategy and Action Plan For Informal Enterprises	X			X		X	
2	Livelihood Empowerment Against Poverty (LEAP)	X			X		X	
3	National Health Insurance Policy	X			X	X	X	
4	National Urban Policy Framework and Action Plan		X		X		X	
5	Ghana Shared Growth and Development Agenda (2014-2017)	X	X		X			X
6	Draft Participatory Slum Upgrading and Prevention Strategy for Accra		X		X			X
7	Draft National Slum Upgrading Strategy	X	X		X			X
8	Accra Medium Term Development Plan (2014-2017)	X	X	X	X		X	
9	National Water Policy		X	X		X		X
10	National Housing Policy					X		X
11	National Disaster Prevention and Mitigation Plan		X	X		X	X	
12	National Climate Change Policy	X	X	X		X		X
13	Riparian Buffer Policy		X	X		X		X
14	National Climate Change Adaptation Strategy (NCCAS)		X	X		X	X	

Source: Author's construct from a review of various policy frameworks and interventions

Overall, as shown in Table 2.2, the growing attention in policy formulation related to informal urbanisation and climate change in Accra Metropolis has produced mainly discrete and sometimes overlapping policy interventions. A common feature of these policies is the lack of clarity and coherent priority interventions to address the challenge of informal settlements and climate change in Accra. In addition to the consequent socio-economic marginalisation of residents of informal settlements from the historical processes in Accra, the policy frameworks have remained broader guidelines. These policies have not also seen much implementation for many reasons, including duplication of institutional mandates, and competing needs for funding as noted by Owusu and Yankson (2017). This again, makes it important to examine the vulnerability and adaptive responses of residents of informal settlements to climate change-related hazards in Accra Metropolitan Area.

2.4 Conclusion

This chapter has shed light on the context of informal urbanisation and climate change-related vulnerability in the historical context of Accra. The findings of the chapter which show hazard of place are three-fold. First, the chapter shows that the nature of informal urbanisation in Accra is not only accounted for by contemporary social, economic, political and institutional factors, but also historical processes. These factors have accounted for the location of residents of informal settlements in their present communities making them potentially vulnerable to hazards.

Secondly, the chapter also shows that residents of Accra face the impacts of climate change and the related risks such as sea-level rise, coastal erosion, temperature rises and flooding. The social marginalisation of residents of informal settlements who live in hazardous places in the era of climate change, therefore makes them most likely to bear the brunt of future climate change in the city.

Finally, the chapter has shown the gaps, challenges and incoherence of existing policies related to informal urbanisation and climate change adaptation planning in Accra. Specifically, although there have been several policy responses related to informal economic activities and settlements, they have not been coherent and coordinated to effectively respond to the challenge of informal urbanisation. Also, although policy responses to climate change presently recognise the vulnerability of marginalised populations in general, they have remained broader guidelines, and without the required policy action plans, mainly unimplemented. The myriad of challenges includes duplication of institutional mandates, inadequate coordination of the relevant actors and competition for funding among the different levels of state actors, as has been found by Owusu and Yankson (2017). Together, the findings make it imperative for a context-specific study that will unravel the factors that drive the vulnerability and adaptive responses to climate change in informal settlements of Accra.

3 CHAPTER THREE: CONCEPTUALISING URBAN INFORMALITY, VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE-RELATED HAZARDS

3.1 Introduction

This chapter examines the literature on informal urbanisation, vulnerability and climate change adaptation. Its purpose is to situate the thesis within the conceptual boundaries of social vulnerability and adaptation. This includes situating the knowledge gaps in the literature and identifying the methodological approaches as well as theoretical underpinnings to guide the conduct of this study.

The chapter has been structured into six main sections. The first section covers the definition of and an elaboration on the extent of urban informalisation. This is followed by a conceptualisation of vulnerability to climate change in the context of informal urbanisation. Section three explores the concept of adaptation and its relation to climate change in the context of sustainable adaptation in cities. Following these conceptual definitions, the knowledge gaps to which this study responds are presented in the fourth section. The final section then covers the theoretical underpinnings and framework, as informed by the review of empirical studies.

3.2 Urbanisation and Urban Informality; definition and extent

It has been suggested by AlSayyad (2004), that the term ‘urban informality’ was first presented in the work of Juan Pablo Perez Sainz (1989). This usage was in reference to the evolution of the urban informal economy as a form of employment and informal settlement, where informal workers lived. However, the most noted reference of the concept of ‘informality’ is widely associated with Keith Hart (1973) in his study of the living conditions of a migrant community in Accra, Ghana. In this study, Hart (1973) by alternatively using the ‘informal economy’ and ‘informal sector’, pointed out their interlocking nature and the related ‘legitimacies’ and ‘illegitimacies’ of the activities of residents of a migrant settlement in Accra. However, Hart (1973) did not broadly define ‘urban informality’.

A notable definition of ‘urban informality’ is offered by Porter et al. (2011). This definition combines the informal ‘settlement’ and ‘sector’, referring to urban informality as “*modes of human settlements and trade or exchange that occur outside of formal legal structures and*

processes” (Porter et al. 2011, p.115). This thesis, by adopting the definition of Porter et al. (2011), thus views ‘urban informality’ as the totality of the physical and socio-economic manifestations of economic activities and settlements which result from the process of informal urbanisation. Therefore, the two terms of informal urbanisation and ‘urban informality’ are used interchangeably in the rest of this thesis.

The process of informal urbanisation and its outcome - urban informality, have become the nature of contemporary urbanism in developing countries. Today, more than half of the world’s population lives in urban areas, a number projected to increase to almost three-quarters in the next three decades (United Nations Department of Economic and Social Affairs [UNDESA] 2018). This is shown in the over 90 percent of the new global urban population expected in Asia and Africa over the next two decades (UNDESA 2018) where the nature of urbanism is characterised by persistent and/or growing informal economic activities and settlements (Brown, McGranahan & Dodman 2014; Vanek et al. 2014). For example, recent estimates show that about 82 percent of non-agriculture employment in South Asia is in the informal sector, and for South-East Asia, Latin America and Sub-Sahara Africa, this is at 65 percent, 51 percent and 66 percent of non-agriculture employment respectively (Vanek et al. 2014).

In Ghana, about 65.3 percent of non-agricultural employment was accounted for by the informal economy in 2005 (Charmes 2012), which has been estimated at 83 percent in 2013 (Steel 2017). This proportion is relatively lower in Accra, where about 72 percent of its labour force depend on the informal economy for their livelihoods (GSS 2014). The above situation highlights the importance of the informal economy and settlements as a mode of livelihoods and dwelling for urban dwellers in a developing country.

Furthermore, although not all informal economy workers live in informal settlements, a strong synergy between the two has often been established (United Nations Human Settlements Programme [UN-HABITAT] 2011). For example, about a quarter of the world’s urban population living in informal settlements mostly work in the informal economy (UN-HABITAT 2015). For Asia, the proportion of people living in informal settlements stood at 27 percent, compared to 70 percent in Latin America and the Caribbean. Similarly, urbanisation and slum formation growth rates in Africa are almost at par: 4.6 percent and 4 percent respectively in Africa (UN-HABITAT 2009), and over 60 percent of the population of Sub-

Saharan Africans are estimated to live in informal settlements (UN-HABITAT 2015). In Ghana, over 5.5 million of its 24 million population lived in informal settlements in 2001, estimated to grow at 1.8 percent per annum (NDPC 2005). It is therefore not surprising that about 60 percent of Accra' residents are reported to reside in informal settlements (Grant and Nijman 2004).

It is also important to note that, urban informality often co-exists with urban poverty, inequality, inaccessibility, and legality of land tenure in urban areas (De Soto 1988; Dovey & King 2011). Dovey and King (2011), note that many people depending on the informal economy for their livelihoods are often poor and live in 'squatter settlements', 'shanty towns', and 'slums'. This notwithstanding, available evidence shows that some residents continue to live in informal settlements even when their incomes are high for many other reasons (UN-HABITAT 2003). Nevertheless, by the generally poor conditions, a wide range of tenure security patterns, including rental and squatting, and various other forms of land ownership arrangements often exist in informal settlements (Martínez & Roitman 2019).

A major distinguishing factor of the different types of informal settlements in the literature is the nature of tenure security of the community. An often-cited and notable typology of informal settlements that is based on this criterion has been offered by Dovey and King (2011) who categorised informal settlements into three major forms. The first describes informal settlements occupied by indigenous people or the original owners of the land where there is no formal city planning. This first group of settlements is termed *settling*. By contrast, the second type of informal settlements often occupied by non-owners of the land involving the unauthorised occupation of State-acquired lands, marginal lands such as river banks, water bodies, spaces located next to railway lines; this type and process are termed *insertion*. Generally, informal settlements which are described as insertion are usually slow in their formation and take place over a long period (Amoako 2015; Dovey and King 2012).

Unlike the earlier two, the third type of informal settlements always develops spontaneously in open spaces in already developed areas (Dovey & King 2012). This process includes activities in streets in partially formally planned precincts (Amoako 2015; Dovey & King 2012). Dovey and King (2011) refer to this process of informal settlements' development as *attaching*. Based on this categorisation, the nature of tenure security is often determined by the extent to which

the existing planning regulations and building codes (institutional arrangements) are enforced in the city. By the different land ownership arrangements, it has been suggested that residents of settlements described as *attaching* or *inserting* are typically forcefully evicted, especially during urban renewal projects (Dovey & King 2012; UN-HABITAT 2006). By contrast, residents of settlements described as *settling* tend to relatively more receive the attention of state authorities through the provision of minimum amenities, and in some cases, state institutions strategically remain inactive in those settlements (Amoako 2015). The four case study settlements in this thesis were selected to reflect these different types of settlements.

3.3 Vulnerability

3.3.1 Defining Vulnerability

Definitions of the key concept of vulnerability vary according to the discipline of study. However, these definitions may be categorised into scholarly groups of interest in natural hazards, socio-political systems, and climate change. An example from the risk-hazard literature is by Blaikie et al. (2014, p.9), who assert that, it is important to view vulnerability as the “*characteristics of a person, a group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural disaster*”. Another definition in the hazard literature is by the United Nations International Strategy for Disaster Risk Reduction (UNISDR) (2004, p.4), who view vulnerability as a set of prevailing conditions resulting from a community’s existing physical, environmental, political, socio-cultural and economic situation. This emphasis on socio-economic and political aspects of vulnerability is further highlighted by Birkmann (2006 p.15), who notes that “*...vulnerability represents the system or the community’s physical, economic, social or political susceptibility to damage*”. Cutter et al. (2008) refer to this socio-economic emphasis in the framing of vulnerability as a pre-existing condition to disasters which varies according to locations and time. As a pre-existing condition, households become exposed to climate-related risks, which become hazards that affect their wellbeing. The impacts of such hazards are usually measured by the actual outcome, such as sickness, nature of property damaged or even loss of lives.

The view of vulnerability in the climate change literature draws mainly from the literature on natural hazards, as well as debates in entitlements and human capabilities (Adger et al. 2007). Known in a section of the literature as integrated vulnerability, the Intergovernmental Panel on Climate Change (IPCC) (2007, p.883), conceives vulnerability as “*the degree to which a system*

is susceptible to and unable to cope with the adverse effects of climate change, including climate variability and extremes". This definition includes the nature, intensity, and frequency of the impact of climate change to which a household is exposed, and its capacity to respond effectively. The adaptive unit's capacity to adapt is referred to as 'adaptive capacity' (Smit and Wandel 2006, p.286-7). Related to this definition is the concept of 'sensitivity', which is explained as the degree to which a household or community is affected by the adverse impacts of climate change (Smit and Wandel 2006). The framing of vulnerability can, therefore, be categorised into two strands as "social" or "biophysical" vulnerability, the latter referring to biophysical conditions while the former is the socio-economic and political condition of the social system in consideration (Füssel 2007). By 'social', the urban poor who are often differentially socially, economically and politically excluded are viewed as most likely vulnerable to hazards in urban areas. It is worth to note however that, vulnerability is not always equated with poverty as "*not all poor people are vulnerable to all hazards, and some people who are not poor are also vulnerable*" to some hazards (Gencer 2013, p.14).

3.3.2 Dimensions of Vulnerability of Residents of Informal Settlements

Different dimensions of vulnerability are notable in the existing literature on informal urbanisation. In this section, the notable among which are forced evictions, limited access to housing and land markets, and absence of infrastructure and public services as well as political exclusion, are discussed.

Evictions and physical harassments

Earlier scholars such as De Soto (1989) and Perlman (1979) have noted that the residents of informal settlements are not always 'passive victims' of harassments and evictions. They also often engage in economic activities as well as mobilise themselves to rebuild their assets after forced evictions. Emphasising this view, Roy (2011, p.14) asserts that it is important to view informal settlements as "*terrain of habitation, livelihood, self-organisation, and politics*". Other scholars, such as Lindell (2010) and Obeng-Odoom (2011), also discuss the socio-political activities of residents of informal settlements. For example, Obeng-Odoom (2011) gives an account of how residents of informal settlements mobilise for collective action, to prevent the city authorities from carrying out evictions in their settlements in Accra.

Nevertheless, various scholars have discussed how residents of informal settlements are often evicted and physically harassed in cities in Latin America (Bromley and Mackie 2009; Crossa 2009; Donovan 2008), Africa (Obeng-Odoom 2012), and Asia (Kagawa & Bailey 2006; Lata, Walters and Roitman 2018). Lata, Walters and Roitman (2018) show that although collective resistance was not possible, informal vendors in Dhaka (Bangladesh) entered into extortionary relations with agents of the state, paying in return for access to public space as an input for their livelihoods. Overall, the evictions and physical harassments often suffered by residents of informal settlements add on to their precarious socio-economic and political conditions, as various forms of their vulnerabilities.

Limited access to housing and land markets

Limited access to the formal housing and land markets is another dimension of the vulnerability of residents of informal settlements in developing countries. By their limited access to resources, residents of informal settlements have limited choices in the urban land and housing markets. This combines with their inability to afford well-planned and serviced sites, leading to sub-standard housing in hazardous places (Baud, Sridharan & Pfeffer 2008). Mitlin and Satterthwaite (2013) extend this discourse in noting that the majority of residents of informal settlements in cities of developing countries are often exposed to hazards owing to their location in hazardous places.

A second dimension of the housing conditions of many informal dwellers is the typical high densities in informal settlements. Inability to afford appropriate plot sizes and increasing population often lead to high densities, with overstretched communal amenities in informal settlements (Mitlin & Satterthwaite 2013). In the slums of Lima (Peru), a gross density of 527 residents per hectare, was reported by Harms (1997). In the context of Accra, while an estimated 60 percent of the city's population reside in informal settlements, they occupy only less than a quarter of the total land area (UN-HABITAT 2011). This has been estimated at 608 persons per hectare much higher than the 251 persons per hectare in the whole Accra (UN-HABITAT 2011). Similarly, Zoleta-Nantes (2000, p.70) reported this congestion from her study of flood vulnerability in Metro Manila, describing informal settlements as the "*lowliest urban neighbourhoods in the congested parts of the metropolis*". The nature of this congestion and related vulnerabilities further justify the need for examining the living conditions of informal settlements in Accra.

Limited to no presence of infrastructure and social services

Limited to the near absence of public services and infrastructure is another aspect of the vulnerability of residents of informal settlements (Satterthwaite 2007). The limited mandate of city authorities in the provision of some categories of public services is an important point to note. However, the distribution and access to basic amenities in cities typically more favour the formal areas of cities, while residents of informal settlements are usually denied, or have very little access to social services (Hardoy & Satterthwaite 2014b). In Accra, while 59 percent of the residents access door-to-door waste removal services (GSS 2014), only about five percent of residents in informal settlements have their waste removed by waste contractors (AMA & UN-HABITAT 2011). Similarly, Akuffo (2007) found that only about eight (8) percent of residents of informal settlements in his study in Accra had water connection into their homes. This limited presence or near absence of infrastructure tends to negatively impact the wellbeing, thereby increasing informal settlements' residents' vulnerability to hazards.

It must, however, be noted that while the physical nature of informal settlements makes it difficult for the extension of public services and infrastructure provision, the residents often pay very high amounts for the limited supply of public services. A study by UN-HABITAT (2004), indicates that such residents pay private vendors between four to ten times more per litre of water than the middle and upper-income groups who benefit from formal water connection. Overall, this suggests that the unavailability of social amenities in informal settlements may sometimes not reflect a lack of effective demand for the same. However, paying a higher cost of urban services further render informal settlements' residents more economically vulnerable.

Limited presence of public institutions and political exclusion

The vulnerability of residents of informal settlements is further characterised by their limited access to public institutions and exclusion from governance in cities. Mitlin (2008) suggests that while residents of informal settlements have and often drawn upon their social capital to mobilise themselves, compelling evidence suggests that they tend to be politically under-represented in cities. In contrast, Drakakis-Smith (1976) discusses how residents of informal settlements mobilised themselves in agitating for their recognition by city authorities leading to the provision of surfaced roads in their communities in Ankara, Turkey. Similarly, Abers (1998) also discusses how slum dwellers mobilise themselves to increase their participation in

governance and negotiate for social services in Porto Alegre, Brazil. This is similar to the work of Roitman (2019b) in Yogyakarta (Indonesia). Examining two urban groups, Roitman (2019b) shows both the different and similar strategies that are often adopted by residents of informal settlements and a diverse group of dissatisfied urban dwellers in reclaiming their right to the city. Although different in origin from the urban dwellers and more marginalised, informal settlers have devised effective strategies, built on collective action, to express their demands and receiving the attention of state authorities in Yogyakarta (Roitman 2019b).

This notwithstanding, Beard (2000) shows that the nature of poverty among residents of informal settlements, may itself reduce the social networks on which they depend. This then sometimes renders informal settlements' residents unable to reciprocate help they receive from others. For this reason, McGranahan, Mitlin & Satterthwaite (2008) conclude that residents of informal settlements generally tend to be excluded from the formal governance processes in cities of developing countries. The scholars later assert that the residents generally tend to have limited access to public institutional coverage and are mostly with little to the near-total absence of social amenities, making them vulnerable to hazards (Mitlin & Satterthwaite 2013).

Limited access to formal employment and social benefits

The socio-economic contexts of informal settlements are also characterised by lack of access to formal employment and low wage employment in the informal sector (Bromley 2013; Wekesa, Steyn & Otieno 2011). Although not all informal employment pays less than formal employment, formal employment guarantees social security, while informal livelihoods tend to be precarious. Evidence from a study by Alwang, Mills and Taruving (2002) in Zimbabwe show that much of the increase in poverty in the early 1990s was more associated with households that were dependent on the informal sector for their livelihoods. The limited earnings from these jobs, coupled with high food and non-food expenditure, was found to have made them vulnerable to ailments (Alwang, Mills & Taruvinga 2002). Added to this vulnerability is the absence of social support from the state, which further worsened their vulnerable conditions (Alwang, Mills & Taruvinga 2002).

In summary, this section shows that residents of informal settlements who tend to have lower levels of educational qualifications, limited access to formal sector jobs, and earnings potential, are limited by their participation in the informal economy. Also, the informal land titles that residents of informal settlements often obtain outside the formal urban planning regulation

system makes it difficult for them to access credit or insure their property (UN-HABITAT, 2003). Put together, these factors negatively impact on the living conditions of informal settlements, making them potentially more vulnerable to hazards. It must, however, be noted that residents of informal settlements are not a homogenous group of poor people. Informal settlements' residents are differentiated by socio-economic characteristics, such as gender, level of education and ethnicity. Therefore, the different socio-economic characteristics can differentially influence informal settlements' dwellers' vulnerability to climate change-related hazards.

3.3.3 Climate Change-related Vulnerability in Urban Informal Settlements

Climate change is one of the most significant development challenges confronting humanity in the present and future centuries. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as:

..[a] change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods (UNFCCC, 1992 p.7).

Contrary to the UNFCCC, the Intergovernmental Panel on Climate Change (IPCC) (2013) although also acknowledging human activity as the main cause of climate change, the experts do not solely focus on human activity in the sense that natural forces also account for changes in climatic conditions. Nevertheless, the social construction of climate change is informed by the agreement of most climate scientists that human activities, such as industrial production which contributes to generating greenhouse gases significantly account for current climatic conditions (Houghton 1999; IPCC 2007b).

Furthermore, it has been shown that emission of greenhouse gases, dating back to the industrial revolution has increased by about up 70 percent over only 30 years in 2004 (IPCC 2007). Relating to this is increasing global average temperatures by 0.8 degrees Celsius of pre-industrial level, projected to a crisis point of above 2 degrees Celsius by 2030 (IPCC 2013). The related rises in sea levels are projected to 5.8 cm, 16.5 cm and 34.5 cm by 2020, 2050 and 2080, respectively (IPCC 2013).

Climate change and variability-related extremes have been associated with hazards such as floods, cyclones, and droughts, which are already being felt in different regions in the world (Akbar & Kinnear 2010; IPCC 2014; Symes et al. 2009). As adaptive capacities vary among

nations, cities and communities, the impacts of climate change-related hazards have also been varied. Examining data from multiple sources, Peduzzi (2006) suggests that while about 11 percent and 15 percent of people in developing and developed countries respectively, may be exposed to hazards each year, about 53 percent of people affected in developing countries die. This is compared to only 1 percent in developed countries who die from disasters (Peduzzi 2006).

Moreover, variations in adaptive capacities have meant that, although Africa's contribution to greenhouse gas emissions is negligible by global standards, the continent is recognised as the most vulnerable region (IPCC 2007). This has been attributed to endemic poverty, limited access to capital, socio-political challenges including conflict, and poorer infrastructure in urban areas (IPCC 2007). For instance, the IPCC (2007) projects between 75 and 250 million people living in Africa will be exposed to increased water stress as a result of climate change by 2020 and millions are expected to die. This is in addition to a projected reduction in yields from rain-fed agriculture by about 50 percent in some African countries, threatening food security. Direct consequences of climate change on food insecurity, have meant that the urban poor, including residents of informal settlements, are likely to continuously bear the brunt (IPCC 2007).

Furthermore, the projected rise in sea levels associated with climate change has been estimated to affect many low-lying coastal cities in Africa, including Accra. It has been estimated by the IPCC (2007) that, responding to these impacts could require at least five (5) to ten (10) percent of Gross Domestic Products (GDP) of African countries. Indeed, African countries are already experiencing the negative consequences of climate change. For instance, in 2000, floods from excessive rains and cyclones occurred in Mozambique affecting 800,000 people, 700 deaths were recorded while over 250,000 people were rendered homeless (Dankelman 2002). The sub-continent of West Africa has particularly been identified as one of the most vulnerable areas to climate change, especially drought, desertification and flooding (Denton 2002). In Accra, following unexpected volumes of rainfall in 2015, over 135 people lost their lives due to flooding and flood-induced fire outbreaks (Appiah 2015).

It is in this context that the vulnerability of residents of informal settlements to climate change-related hazards has been suggested by the IPCC (2001). They note that "*squatter and other*

informal settlements with high population density, poor shelter, little or no access to resources such as safe water and public health services, and low adaptive capacity are highly vulnerable” to climate change (IPCC 2001, p.13). Satterthwaite (2011) presents two explanations for this observation by the IPCC. The first is due to the location of residents of informal settlements on low-lying marginal lands and water bodies, often avoided by the relatively wealthier in society, making them more exposed to climate change-related hazards. The second reason is the eviction of residents of informal settlements by city authorities, which is compounded by their neglect in the provision of infrastructure, often due to their lack of land ownership rights. In noting these views, Gencer (2013) stresses that, by interacting with natural environmental hazards with very little or no access to credit and the urban land, housing, and labour markets, residents of informal settlements will be more likely vulnerable to climatic hazards.

Overall, two views of vulnerability that emanate from this discussion are: “*vulnerability from*” and “*vulnerability to*” to a phenomenon. As “*vulnerability from*”, this describes a particular outcome such as homelessness resulting from evictions in informal settlements, while “*vulnerability to*” describes the particular risk or form of exposure to which residents of a settlement are exposed (Ensor & Harvey 2015). In viewing vulnerability more comprehensively, this thesis views vulnerability as both “*vulnerability to*” and “*vulnerability from*”, the varied socio-economic and political, as well as climate change-related hazards in informal settlements.

3.4 Adaptation Practices and Dimensions

3.4.1 Defining Adaptation

Like vulnerability, conceptions of adaptation vary among scholars in disaster risk and climate change literature who subtly use different words to describe similar processes. An example from the disaster risks literature is by UNISDR (2004 p.9) who describe “*the process through which people or organisations use available resources and abilities to face adverse consequences that could lead to disasters*” as coping responses. Further clarifying this, Wisner et al. (2005) assert that coping assumes that future events follow similar patterns as the previous, and lessons from previous responses are a reasonable guide for similar events. A broader view is adopted in the climate change literature as by the Intergovernmental Panel on Climate Change (IPCC) (2007) who conceive adaptation as: “*adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates*

harm or exploits beneficial opportunities” (IPCC 2007, p.6). Previously emphasizing the quality of the system to adjust, Pielke (1998 p.159) defines adaptation as: *“adjustments in individual groups and institutional behaviour in order to reduce society’s vulnerability to climate.”* Similar to the view of Pielke (1998), Burton *et al.* (2002) suggest that it is more useful to view adaptation as involving the prevention of, reduction in the effects of climate change/variability while taking advantage of the opportunities presented by such changes. These conceptions do not highlight the livelihoods aspects for households and communities, which is the focus of Ahmed and Fajber (2009).

For Ahmed and Fajber (2009, p. 35) adaptation generally involves *“adoption of strategies in developing resilient and flexible livelihood strategies under stress to respond to the impact of climate change”*. The varied dimensions of adaptation to climate change are surmised by Moser and Ekstrom (2010, p.1) who submit that adaptation *“involves changes in socio-ecological systems in response to actual and expected impacts of climate change within the context of interacting non-climatic changes”*. Nevertheless, it is important to note that adaptive practices in a community may go beyond responding to climate change.

According to Schipper (2007), the growing theoretical debates on adaptation have led to a focus on definitions, to the neglect of an understanding of the actual adaptive experiences of urban communities. Explaining further, Shipper (2007), suggests that it is more useful to view adaptation more broadly as part of development. Nelson and Palmer (2007) refer to this broader view of adaptation by suggesting that adaptation is:

the decision-making process and a set of actions undertaken to maintain the capacity to deal with current and 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 (p. 397).

The views of adaptation have also sought to call for a shift from the evolutionary-biological and ‘systemic’ framing, to an anthropological perspective. This is exemplified in the view of O'Brien, Clair and Kristoffersen (2010), who emphasise the sociological aspect of adaptation. They contend that understanding the sociological part of adaptation requires a focus on how *“people add on new and improved methods of coping with the environment to their cultural practices”* (p.10). This cultural dimension is what Ensor and Berger (2009) argue as embedded in the cultural beliefs of people, which influence their perceptions about risks and subsequent decision to respond to such risks.

The role of a household or community's knowledge of hazards is thus part of the framing of adaptation within this sociological framing. For instance, Hilhorst (2003) and Villarreal (1994) discuss the relationship between local knowledge and scientific knowledge in adaptation processes. Extending this view, Hilhorst (2003) contends that, since a household's knowledge is embedded in their culture, the cultural beliefs held by a household will influence their knowledge about hazards. This may further influence their view on how they receive or reject external scientific knowledge in a community. Advancing this further, Hilhorst (2003) suggests that, the bureaucrats equally often neglect local knowledge, if this is considered at odds with scientific knowledge.

Also important in the debates of adaptation is the role of institutions. Burton et al. (2002) refer to the institutional and behavioural aspects of adaptation in their view of adaptation as:

a wider 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 climate variability and change (p.145).

This view of adaptation encompasses regulations and policies, which differs from the relatively narrower view of adaptation by, for example, the IPCC (2003).

Indeed, the importance of institutions in the adaptive practices of informal settlements cannot be over-emphasised. To scholars such as Hodgson (2007), institutions are “*systems of established and prevalent social rules that structure social interactions*” including the organisations (p.2). North (1990), however, differs from Hodgson (2007) by separating institutions from organisations, emphasising that institutions set the boundaries for the conduct of actors. The view of institutions by Agrawal and Perrin (2009) also differs, as they see institutions as “*humanly created formal and informal mechanisms that shape social and individual expectations, interactions and behaviour*” (p.15). It is in these contested framings that the nature of institutions in the context of informal urbanisation and adaptation to hazards may be understood.

According to Hodgson (2007), institutions are categorised into informal and formal realms. Formal institutions refer to codified rules, while informal institutions are usually socially shared unwritten rules and norms. In the context of informal settlements, examples include the rules that govern land transactions or the use of other natural resources such as water. On the

other hand, formal institutions will include formal regulations, legislation and policies that guide the conduct of organisations (including state institutions) involved in governance in the city. Understood this way, Moser et al. (2010) therefore assert that households' adaptive responses to climate change in informal settlements do not take place in a vacuum, but rather regulated by the prevalent laws, legislation and norms (institutions) in that community and city.

3.4.2 Types and Categories of Adaptation Practices

Understanding the different types and categories of adaptation is important for analytical purposes. The literature on adaptation often refers to 'types' (IPCC 2001), or 'categories' (Yarnal 2007) of adaptation. For instance, notable literature such as IPCC (2001) groups adaptations by types based on 1) who funds or initiates adaptation actions; and 2) whether they are planned or unplanned. While adaptation actions that are funded or sponsored by state institutions and intended for public benefit are termed public, those initiated by individual households are termed private adaptive responses, as they are typically meant for private benefits (IPCC 2001).

The second typology of adaptation practices suggested are termed planned or autonomous (IPCC, 2001). Planned adaptation often involves deliberate actions in the form of policy interventions by public agencies based on an assessment of potential impacts of hazards, and are usually meant to minimise losses to the population (Pittock & Jones 2000). This differs from autonomous adaptations, which are usually unplanned. Markanandya and Chiabai (2009), suggest that the decision-making processes and careful planning involved in planned adaptation make it more potentially impactful, compared to autonomous adaptation. Nevertheless, the boundaries between planned adaptation and autonomous adaptation tend to be fluid, since some planned adaptive responses sometimes precede autonomous adaptive responses (Ahmed and Fajber 2009). In the context of this study, resettlement of informal settlements from a flood-prone area, or provision of drainage infrastructure in an informal settlement, will be considered a planned adaptive response. Autonomous adaptive responses, on the other hand, are those unplanned responses to climatic hazards often taken by households in informal settlements (Roy et al. 2016).

Adaptation actions have also been categorised in the risk-hazard literature as 'preventive', or 'impact minimising', (Blakie et al. 2004, Yarnal 2007). By 'preventive measures', these have

been suggested as those taken by a household or community to avoid being affected by an anticipated socio-ecological risk. This differs from ‘impact minimising’ measures, which are usually undertaken to minimise the impact of the hazard that is mostly already occurring (Blakie et al. 2004, Yarnal 2007). Such adaptive measures are also viewed as ‘non-hazard specific’ or ‘hazard-specific’, depending on whether they are intended to respond to specific hazards, or reduce the overall contextual vulnerability of households (Blakie et al. 2004, Yarnal 2007). In between these categories of adaptation are mitigation measures. These are typically undertaken before the occurrence of an event, to limit the adverse effects of the risk (Schipper & Pelling 2006). When related to livelihoods, the term security is often applied to mean that adaptive livelihood options of households are meant to minimise the myriad of socio-economic, political and ecological risks to which they are exposed (Blakie et al. 2014). It must be noted, however, that the term ‘mitigation’ as applied in the risk-hazard literature does differ from its meaning in the climate change literature, where it refers to activities that are often intended to reduce the production of greenhouse gases.

Mitigation measures are also viewed as ‘structural’ or ‘non-structural’ responses (Parker 2000a; Smit & Pilifosova 2003). Structural responses, refer to physical interventions such as embankment and other physical constructions that are typically constructed to protect people from physical hazards (Parker 2000). On the other hand, ‘non-structural’ responses typically seek to reduce the impacts of hazards, while building a household’s resilience for their long-term exposure to hazards. In the context of informal settlements, Parker (2000) has emphasised the importance of non-structural measures such as the availability of weather warning information, adoption of appropriate building regulations, appropriate land-use controls, and availability of insurance services for adaptation to flooding. This thesis operationally views the adaptive responses in informal settlements as both ‘structural’ and ‘non-structural’ responses but does not distinguish between coping and adaptive strategies.

3.4.3 Adaptation as Development

A relationship between adaptation and development has often been emphasised in the current discourse on sustainable development in cities (Ayers & Dodman 2010; Huq et al. 2007). For instance, Huq et al. (2007) assert this relationship by noting that:

...good (or sustainable) development (policies and practice) often lead to building adaptive capacity. Adaptation to climate change often also means doing good (sustainable) development (p.25).

This view can be understood in the context of the framing of sustainable development as development that meets the needs of the present generation without compromising the needs of future generations (Brundtland 1987). Current global efforts on sustainable development, as articulated in the Sustainable Development Goals (SDGs), have sought to respond to urban vulnerabilities and climate change. For instance, while Goal 11 seeks to achieve sustainable cities and communities (SDG 11), Goal 13 focuses on the need for action on climate change (SDG 13). Goal 10 which focuses on addressing inequalities (SDG 10), relates closely to Goal 8, which seeks to address economic growth (SDG8) (United Nations 2015). Understood as inter-related goals, the pursuit of sustainable development in a city will contribute towards its sustainable adaptation to climate change.

Combining the idea of sustainability and adaptation, O'Brien and Leichenko (2008, p.31) describe sustainable adaptation as “*entailing measures that reduce vulnerability and promote long-term resilience in a changing climate of an area*”. When understood this way, measures to achieve sustainable adaptation in a city will include responding to socio-economic processes of marginalisation and the related vulnerabilities in informal settlements in the city. This knowledge is especially important in the debates on sustainable adaptation, maladaptation and climate change in cities (see, Ayers and Dodman 2010; Huq et al. 2007).

By maladaptation, this is meant a scenario where adaptation decisions were taken to address climate-related vulnerabilities, which adversely increase the vulnerability of others and their ability to adapt to future hazards. Ensor and Berger (2009) suggest that maladaptation may occur both deliberately or inadvertently. This may be deliberate in the form of a policy response by the state, such as forced eviction of residents of informal settlements to make way for flood interventions in a city. On the other hand, inadvertent causes of maladaptation may include the impacts of unintended actions, such as the provision of inaccurate weather warning information to residents of informal settlements. Thus, avoiding maladaptation in responding to climate change-related hazards in a city, will contribute to social inclusion, building resilience as well as a sustainable adaptation of the city.

3.5 Review of Empirical Literature and Knowledge Gaps

Generally, studies on hazard vulnerabilities and adaptive responses in informal settlements have been framed within the broader human security approach. Research framed in this approach has often assessed social and institutional factors that influence access to resources,

vulnerability as well as the capacity of households and communities to respond to social and environmental changes (O'Brien, Clair & Kristoffersen 2010). In this section, a number of these studies are reviewed to identify the specific knowledge gaps to which this study responds. This review is also to unravel the theoretical underpinnings and methodologies that may be adopted to contextualise analysis of the research questions in this study. The section is organised into overviews of studies on vulnerability to hazards; knowledge of climate change; and adaptive responses in informal settlements.

3.5.1 Overview of Studies on Vulnerability of Residents of Informal Settlements to Climate Change-related Hazards

Globally, scholars working in developing countries have examined the vulnerability of residents of informal settlements to climate change-related hazards, predominantly with theoretical frameworks from political ecology (Aboagye 2012b; Adeyemi & Disu 2012; Afeku 2005; Blaikie et al. 2014; Pelling 1997; Zoleta-Nantes 2000; Zoleta-Nantes 2002). According to these scholars, the social, economic, political and institutional contexts of residents of informal settlements differentially account for their vulnerability to flood hazards. These socio-economic and political processes are rooted in historical processes, as well as contemporary developments, such as the adoption of market-economy oriented policies in developing countries as well as colonialism (Aboagye 2012; Pelling 1997). Pelling (1997) in his study in George Town (Guyana), has argued that the present vulnerability of the residents of the selected settlements to flooding is not only accounted for by climate change but rooted in historical processes of marginalisation that date back to the period of colonisation of Guyana. Similarly, Ajibade and MacBean (2014) have argued that socio-economic and political exclusion has resulted in poor housing policies and income inequality in Nigeria. This context has accounted for the present location of slum dwellers in hazardous places, making them vulnerable to flooding hazards in Lagos (Ajibade and MacBean 2014).

Scholars working in Accra, such as Aboagye (2012), Afeku (2005) and Karley (2009) have similarly examined the vulnerability of residents of informal settlements to flooding. They argue that historic political, economic and social factors have accounted for rural-urban migration. The resultant increases in Accra's population have led to the location of informal settlements' residents in hazardous places, making them vulnerable to flooding (Aboagye 2012; Afeku 2005; Karley 2009). This discourse has been advanced by Amoako (2015) and

Amoako and Inkoom (2018) who draw attention to the processes through which residents of informal settlements aggregate, and build their dwellings. Development of these dwellings, which is often without the support of the state and provision of social amenities has influenced slum dwellers' vulnerability to flooding hazards in time and space in Accra (Amoako 2015).

Knowledge gap

Aside the excessive focus of this scholarship on vulnerability to flooding, very few notable scholarly works such as Isunju, Orach and Kemp (2015) have modified this 'researcher-oriented' ontology that is associated with the dominant theoretical framing. The predominant approach through which scholars ascribe informal settlements residents' flood vulnerability to a suite of socio-economic and political factors (drivers), overlooks their agency and knowledge in the determination of vulnerability, as a contextual experience. Nevertheless, vulnerability to hazards which is location and context-specific is also influenced by the unique local circumstances of the household and can be analysed with the involvement of the views of those affected (Adger 2006). Moreover, the approach in which scholars exclude the perceptions of the actors in determining the drivers of their vulnerability to the many climate change-related hazards in informal settlements is problematic since:

...events about hazards often interact with social, economic, political, institutional, and cultural processes in ways that can either heighten or attenuate individual and social perceptions of risk and shape risk behaviour or response by the individual [or group of individuals in a household] (Renn et al. 1992 p.137).

Apart from this, research by Isunju, Orach and Kemp (2015) shows that an analysis of the drivers of 'perceived vulnerability' allows scholars to determine the most significant of the drivers for a more targeted policy response. The scholars show that, while a suite of factors may have influenced slum dwellers' vulnerability to floods in Kampala, the most significant factor that was associated with their perceived vulnerability was their previous exposure to flooding. By so doing, the scholars extended the discourse of social vulnerability by making an ontological contribution about the predominant political ecology frameworks that are often applied in vulnerability studies. However, this study was limited in scope to flooding.

A notable exception to these studies which more broadly examined the drivers of vulnerability to wider climate change-related hazards is seminal work conducted by Roy, Hulme and Jahan (2013) in Bangladesh. However, by the analytical approaches adopted, the exact factors most associated with the respondents' perceived vulnerability remained unexamined. This is also

against the fundamental backdrop that: “*context is king for vulnerability and adaptation to climate in cities*” (Wilbanks et al. 2007 p.15). Thus, the knowledge of the vulnerability of residents of informal settlements to climate change in one city may vary from that of another city with varied policy and practice ramifications. This will even vary between different settlements in the same city, due to the peculiar contextual socio-economic and political characteristics, experiences and perceptions of the residents.

Despite this recognition, the scholarship in Accra has been similar to the global scholarship, in its excessive focus on the analysis of vulnerability to flooding hazards (example, Aboagye 2012; Afeku 2005; Karley 2009). Karley (2009) has shown that the adoption of structural economic as well as political reforms in Ghana has priced out the urban poor from the land and housing markets, influencing their location in hazardous places and intensifying their vulnerability to flooding hazards. However, the exact drivers that are most associated with the perceived vulnerability of residents of the different types of informal settlements in the Accra Metropolitan Area remain unexamined. This gives rise to the first research question of this thesis as:

Question 1: Which factors drive the vulnerability of residents of informal settlements including climate change-related hazards as a contextual experience in Accra?

An examination of this question has the potential to generate knowledge for evidence-based policy-making and climate change adaptation planning practice in the city. This is important since the impacts of climate change-related hazards are projected to increase in Accra (MEST 2013).

3.5.2 Overview of Studies on Knowledge of Climate Change among Residents of Informal Settlements

Scholars have examined the nature of knowledge of climate change and its role in shaping both the vulnerability and adaptive responses to hazards among urban dwellers (Codjoe, Owusu and Burkett 2014; Wamsler and Brink 2014; Zoleta-Nantes 2002). This scholarship sheds light on the nature and sources of knowledge of climate change, which include formal state sources, family, television and radio, all of which enable urban dwellers prepare and respond to climate change in Africa (Codjoe, Owusu and Burkett 2014), Asia (Zoleta-Nantes 2002) and Latin America (Wamsler and Brink 2014). Put succinctly, Zoleta-Nantes (2002), reports that “*the*

community members' access to information and their knowledge related to the occurrence and recurrence of disastrous events do affect the variation in their hazard experience" in Metro-Manila, (Philippine) (p.240). Similarly, Wamsler et al. (2012) in their study in slums in Latin America report that the residents' socio-economic characteristics influenced their knowledge and capacity to respond to climate change. In this study, it was found that long-term residents and those with formal education had more knowledge of climate change than other residents. Moreover, the more educated residents were found as comparatively more capable of responding to climate change-related hazards (Wamsler et al. 2012).

Similarly, Roy and Sharma (2015) found that residents of slums in Jamnagar (India), had low levels of knowledge of climate change. This was partly associated with their lower levels of education and access to knowledge-related resources such as radio and television sets.

Knowledge Gap

However, as noted by Wamsler et al. (2012), only limited scholarly attention tends to be paid to the examination of grassroots' knowledge of climate change in cities in developing countries. This is in spite of the comparatively less developed early warning systems for disaster response. Nevertheless, Hilhorst (2013) has noted that local knowledge can contribute to a more comprehensive contextual understanding of how disaster risks evolve, which is useful for adaptation planning in cities.

In Accra, pioneering work by Codjoe, Owusu and Burkett (2014), found that residents of three underprivileged settlements know about climate change, noting the potential of this to influence adaptation planning in the city. Despite this recognition, the potential synergy of this knowledge with scientific knowledge among residents of the different categories of informal settlements remains unexamined although considered important for adaptation planning, as has been noted by Abeka (2015). Apart from this, the acknowledge of climate change required for adaptation at the city level may be influenced by the local context as well as several actors interacting at multiple levels (Abeka 2015). This gives rise to the second question of this thesis as:

Question 2: In which way does the context of residents of informal settlements influence their knowledge and capacity to respond to climate change in Accra?

Such an analysis has the potential to generate knowledge on the nature and potential synergy of local and scientific knowledge of climate change for adaptation planning in the city. This is crucial since the impacts of climate change have been projected to further increase beyond the current knowledge and coping capacity of urban dwellers in Africa (IPCC 2014).

3.5.3 Overview of Studies on Adaptive Practices of Residents of Informal Settlements to Climate Change-related Hazards

In general, studies on the adaptive practices of residents of informal settlements to climate change-related hazards have a predominantly qualitative outlook (Adelekan 2010; Douglas et al. 2008; Jabeen, Johnson & Allen 2010; Rasch 2015; Roy, Hulme & Jahan 2013; Wamsler 2007; Wamsler & Brink 2014). Many of the studies reviewed explain household adaptation to climate change-related hazards as associated with the nature of their vulnerability (Adelekan, 2010; Douglas et al. 2008; Jabeen, Johnson & Allen 2010).

The qualitative studies which have mainly adopted a case study as their research design typically involved focus groups discussions with communities and interviews with households, as the data collection methods (Cissé & Sèye 2015; Douglas et al. 2008; Rasch 2015). Other data collection methods in such studies have tended to include in-depth interviews with key informants, including officials of central and local government agencies involved in climate change governance. Sources of data collection have also included secondary data from archival sources, publications and grey material (Adelekan 2010; Douglas et al. 2008; Jabeen, Johnson & Allen 2010; Rasch 2015; Wamsler 2007; Wamsler & Brink 2014). The studies which have been mostly descriptive in their analytical approaches, do show the diversity of adaptive practices that are often adopted by residents of informal settlements to varied vulnerabilities.

Several unsustainable adaptive responses are reported from these studies. For example, residents of informal settlements do adopt structural measures such as the use of sandbags, raised foundation of pit latrines, perforating holes on walls and adjusting door frames as reported from slums in Africa (Aboagye 2008; Adelekan 2010; Cheikh and Bouchair 2008; Douglas et al. 2008), Asia (Roy et al. 2013) and Latin America (Wamsler and Brink 2014). Other adaptive measures reported include the provision of water outlet pipes above plinth level, elevation of foundations and construction of embankments as well as retaining walls as was

found in informal settlements in Latin America and Asia (Wamsler and Brink 2014; Wamsler 2007).

In addition to ‘structural responses’, several ‘non-structural’ responses are often adopted by residents of informal settlements to minimise climate change-related hazards (Rasch 2015; Wamsler and Brink 2014; Wamsler 2007). Residents of informal settlements in South East Asia (Wamsler and Brink 2014) and Latin America (Rasch 2015; Wamsler 2007), were found to often sleep outside their dwellings, in response to excessive heat. Also, such residents temporarily relocate the young and aged to a safe location during flooding (Rasch 2015; Wamsler 2007). Added to these, residents of informal settlements often organise themselves in order to give their communities a voice in lobbying for social services such as in Suprahat and Magbara settlements in Dhaka (Bangladesh) (Roy, Hulme and Jehan, 2013). Such practice was reported to have helped households develop private adaptive responses, such as constructing tertiary drains to facilitate the flow of water in informal settlements in many cities in Latin America and Asia (Wamsler and Brink 2014).

Furthermore, adoption of political measures by communities, has been found to address political and legal drivers of vulnerability, such as the absence of tenure security and the consequent threats of eviction as in Dhaka (Bangladesh) (Roy et al. 2013) and several cities in Latin America (Roy et al. 2013; Wamsler and Brink 2014). Moreover, the practices reported include the realm of livelihoods, such as economic diversification involving income-generating activities as found in several informal settlements in Latin America (Wamsler and Brink 2014). The sources of funding and support for adaptive responses have also tended to include extended family networks beyond the urban arena to rural households, micro-finance institutions as well as community-based organisations as was found in Indonesia (Baker 2012) and slums in Latin America (Wamsler and Brink 2014). Moreover, although institutional flooding mitigative measures have often excluded residents of informal settlements, the residents often adopt preparatory measures to help them in minimising the impacts of future climate change-related events, such as in Mumbai (India) (Chatterjee 2010) and Korail, Dhaka (Bangladesh) (Jabeen, Johnson and Allen 2010). Furthermore, in Korail and Mohammadpur, Jabeen and Johnson (2013) found a relationship between fatalism and residents’ adaptive behaviour. Fatalism, a belief that the destructive effects of a hazard are inevitable, was said to have accounted for the widespread adoption of adaptive practices in these communities.

Not only do adaptive responses in informal settlements vary, but these practices have also related to the socio-economic and political characteristics of their residents. Roy, Hulme and Jahan (2013) report on the adaptive responses of squatters, as differentiated from the responses often adopted by residents in more secure tenured settlements in Khulna, Bangladesh. The contribution of these studies is that access to and control over productive resources play a critical role in individuals' and households' ability to adapt to crises associated with climate change. Specifically, property owners and long-term residents tend to adopt different adaptive practices in informal settlements; landlords than tenants and long-term residents than short-term residents are better able to adapt to their vulnerabilities. Thus, those with more access to assets are more able to adapt than those with fewer assets, as reported from studies in Africa (Aboagye 2008; Adelekan 2010), Asia (Roy et al 2013) and Latin America (Aboagye 2008; Adelekan 2010; Cheikh and Bouchair 2008; Douglas et al. 2008; Jabeen and Johnson 2013; Moser et al 2010; Roy et al 2013; Wamsler and Brink 2014). Jabeen and Johnson (2013) suggested the adaptive response in Korail and Mohammadpur were very sustainable. However, the adaptive responses generally reported in this scholarship often tend to be mainly reactive and unsustainable.

As in the qualitative studies, the quantitative studies, have tended to be quite similar in their generally descriptive nature, and involved household surveys using structured questionnaires as the data collection method (see, Aboagye 2008; Balgah, Bang & Fondo 2019; Braun and ABheuer 2011; Cissé & Sèye 2015). Analytical approaches in these studies involve mainly descriptive statistical methods such as frequency counts and cross-tabulations (example, Armah et al. 2010; Balgah, Bang & Fondo 2019), while few apply inferential methods such chi-square tests (example, Chatterjee 2010). Several of these studies report relationships between socio-political characteristics and flood responses (Meredith et al. 2013), perception of risks and the influence of cultural beliefs and perceptions (Balgah, Buchenrieder & Mbue 2015). Thus, the adaptive responses of the poor do relate to their socio-physical contexts as has been reported by Boamah et al. (2015) in their study of flood victims in Nigeria and Tanzania.

Few exceptions to these studies such as the work of Chatterjee (2010) and Isunju, Orach and Kemp (2016) determined an association between the socio-economic characteristics of slum dwellers and their adaptive responses to flooding in Mumbai (India) and Kampala (Uganda)

respectively – applying chi-square tests and logistics regression respectively. Overall, this scholarship extends the discourse on ‘adaptive capacity’ and climate change as it shows the influence of the socio-economic and political characteristics of residents of informal settlements, on their adaptive responses to flooding hazards.

Knowledge Gap

In Accra, several scholars have examined the adaptive practices of residents of informal settlements to flood risks, applying quantitative approaches (Abeka 2014; Aboagye 2012b; Mumuni 2013; Twum & Abubakari 2019). For instance, Abeka (2014) determined the correlates of the socio-economic and psychological factors of household heads with their adaptive responses to flooding. This study found four determinants of a household’s adaptive responses to flooding as 1) household’s tenancy status, 2) nature of proximity of their dwelling to a drain, 3) the nature of wall material they used to construct their dwelling; and 4) their length of stay in the community. By contrast, Mumuni (2013), in his study, shows that the perceptions of households in informal settlements about risks, strongly influence their adaptive behaviour towards flood hazards. A recent study by Twum and Abubakar (2019), however, situate the relationship between flood adaptive behaviour and group membership status of household heads as well as social learning. Overall, this scholarship contributes to the ‘adaptive capacity’ discourse, therefore to the question of: ‘who adapts to what and why in the context of informal urbanisation and flooding hazards?’

Conspicuously missing in this scholarship on adaptation in Accra, however, are empirical studies that provide insights into the relationships between the various characteristics of households and their adaptive responses to multiple climate change-related hazards in the different informal settlements. Such an analysis has the potential to assist in further determining detailed drivers of adaptive options that are often taken to minimise vulnerability to multiple climate change-related hazards in informal settlements in the Accra Metropolitan Area. Moreover, the limited attention of studies which focus on analysing the relationships between socio-economic characteristics and adaptive responses to wider climate change-related hazards presents a challenge for local adaptation policy-making and planning in Accra. Vital information on households may be omitted from adaptation policies, plans, and processes in the city. This gives rise to the third question of the thesis as:

Question 3: Who adapts to what and why in the context of climate change-related hazards and social vulnerabilities in informal settlements in Accra?

Apart from this, the new theoretical framework which places human agency and knowledge at the centre of the adaptation processes has the potential to unravel the different ways through which the urban poor may influence their adaptation processes at the city level. This is significant since the study also partly departs from the dominant structuralist framing of the vulnerability and adaptive processes, which have often treated the urban poor as ‘passive victims’ to hazards.

Overall, this study which responds to these three broad research questions also aims to examine the factors that drive the vulnerability and adaptive responses of residents of informal settlements including climate change-related hazards as a contextual experience in Accra. It does so in the context of an integrated theoretical framework. This framework and the theoretical underpinnings are presented next.

3.6 Theoretical Underpinnings and Framework

This section of the chapter describes the theories that underpin various aspects of this study. It first presents political ecology as the theoretical underpinning for social vulnerability and secondly, actor-oriented theory as an integral theory for adaptation practices. In the last section, an integrated framework of political ecology and actor-oriented theory is adapted to contextualise the entire study.

3.6.1 Political Ecology and Vulnerability

In general, most scholars who write on vulnerability to climate-related and other environmental hazards in developing countries situate their discourse in political ecology (Füssel 2007) (see for example, Aboagye 2012b; Adeyemi & Disu 2012; Blaikie et al. 2014; Pelling 1997; Zoletta-Nantes 2002). Blaikie and Brookfield (1987, p. 17), succinctly define political ecology as a broader field of study that:

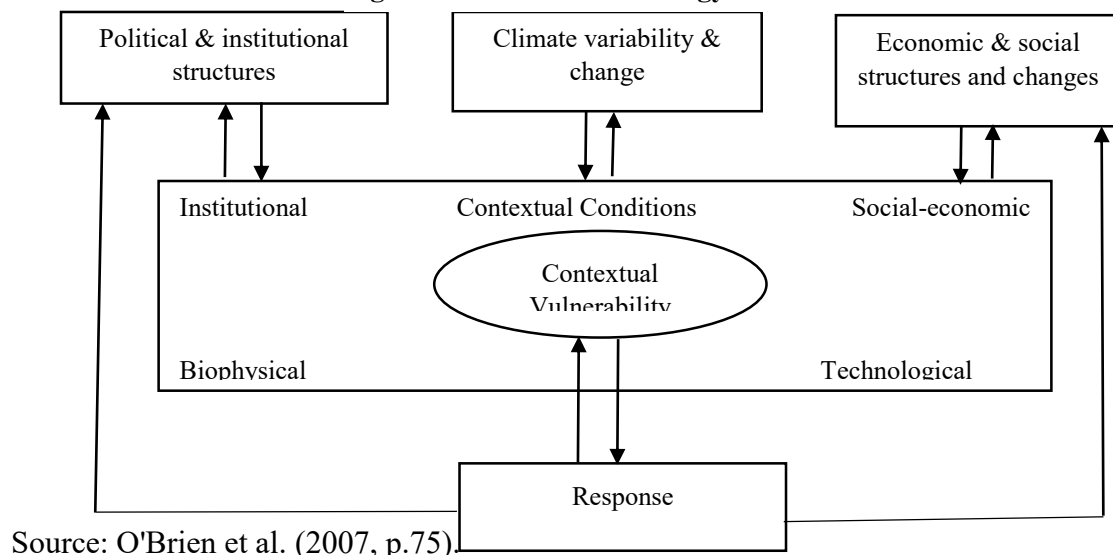
Combines the concerns of ecology and a more broadly defined political economy. Together, this encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself (p. 17).

Political ecology emerged as a dominant discipline and theoretical approach from human ecology and ecological anthropology in the 1970s (Bryant 2001). Its emergence was due to a critique of the poor treatment of politics in human-environment relations in human ecology and ecological anthropology (Bryant 2001).

According to Offen (2004), the scholarship in human geography, often framed within political ecology can be categorised into two. First is research on livelihood production and reproduction, and second is research on colonialism and neo-colonialism relative to conflicts that arise from the use of land-based resources. The commonality of this scholarship is a focus on the nature of access to, and contestations over resources by people in their relations with the state within cities and nations. Aside from focusing on political power, scholars who adopt political ecology frameworks contend that poverty and vulnerability to environmental hazards are accounted for by market failure (Bryant 2001). This vulnerability is viewed as: “*the state of individual’s, households’ or communities’ ability to cope with or adapt to any external burden placed on their livelihoods and general well-being*” (Fussel 2007, p.160).

Prominent political ecology frameworks applied in analysing vulnerability and adaptation to environmental hazards include the pressure and release model (Wisner *et al.* 2004), and its variant in O’Brien *et al.* (2007) (as shown in Figure 3.1). Therefore, rather than asking ‘what and where?’ in vulnerability analysis, adherents of the ‘political-ecology approach’ concern themselves with people, by asking ‘who is most vulnerable and why?’ or ‘which factors drive people’s vulnerabilities to climate change-related hazards?’ (Füssel 2007 p.15). In doing so, the proponents focus on the “*processual and multidimensional view of climate-society interactions*” (O’Brien *et al.* 2007, p.76) and people’s response capacity to climate change in a given place (Figure 3.1). The resultant contextual conditions determine people’s exposure to, and their potential responses to climate change (Figure 3.1). The main component of this framing is its linkage of vulnerability to ‘unsafe conditions’, by showing a relation between contextual vulnerability conditions and the wider national economic and political processes.

Figure 3.1: A Political Ecology Framework



Source: O'Brien *et al.* (2007, p.75)

On the other hand, the proponents of this framing argue that responding to climate change will require modifying the socio-economic context in which climate change occurs. This is to enable individuals and groups to respond better. Therefore measures aimed at enhancing this 'capacity to respond', should concentrate on the social conditions and root causes of people's exposure to hazards in society (O'Brien et al. 2007). In terms of their ontology, adherents of political ecology frameworks are constructionists, and the researcher often explains the nature of the underlying conditions for people's vulnerability to hazards (Füssel 2007). In doing so, the scholars also provide an answer to the question of 'who adapts to what and why'?

However, a general critique of third world political-ecology frameworks is the seeming overbearing focus on external economic forces and political power as the sole determinants of peoples' vulnerability at community and city levels (Vayda & Walters 1999). Moreover, when adopted wholly with the associated ontology, political ecologists often mask the knowledge, perceptions and agency through which local actors may influence their vulnerability context, as has been argued by actor-oriented theorists.

3.6.2 Actor-oriented Theory and Adaptation Practices

The actor-oriented approach to the sociology of development, theorised by Norman Long (1990), has its foundation in Weber's description of social action as both meaning and practice. The theory emerged in reaction to the theories of modernisation in the 1950s, and the dominant dependency theories in the 1960s (Long 1990). Long (1990) does not entirely depart from the political ecologists' view that external economic and political forces influence structural changes on people in communities and cities. However, Long (1990) argues that it is inadequate to analyse social change/processes such as adaptation practices to climate change-related hazards at the community level, only focusing on external interventionism while reducing local actors to passive victims (Long, 1990). For Long (1994), social actors through their daily life experiences and struggles, do mediate and transform external interventions, as they emerge in the world of social actors. Therefore, policy interventions and activities from the state, are conceived as part of a chain of events that emanate from different social interest groups often involved in internal struggles (Long 2004).

Long (1990) articulates how these societal changes occur through what he terms 'domain' and 'arena'. By domain, Long (1990) explains it as social units organised according to norms and values, such as family, community, market or state. Arena, in turn, is explained as the avenues

where the conflicts take place, such as the home, marketplace, and non-tangibles such as the 'battlefield of knowledge' (Long 2003). Three fundamental concepts in this theory seen to derive social change, therefore, are 1) power, 2) human agency, and 3) knowledge (Long 2003).

Human agency is the ability of a person to shape daily life occurrences and events in his/her social setting (Giddens 1984). Understood this way, human agency becomes a collective agency when individuals agree on a common course of action in their social setting (Long 1990).

Also, power - one's ability to act, is continuously negotiated within the social system through struggles among the actors (Long 1999). Therefore, even the weakest in the social structure does exercise agency and can participate in shaping up a collective agency (Long 1990), such as groups of informal settlement's residents protesting for their rights to land in a city.

The other concept 'knowledge' is important as it enables actors to perceive, categorise, process and assign meaning to their experiences within their socio-cultural and institutional settings (Arce & Long 1992). Moreover, knowledge is not homogenous among the actors but contested in the 'battlefield' (Long 1990). In this view, knowledge is not restricted to formally gathered facts about a phenomenon, but also that which evolves outside the formal domain of the state (Long 2004), such as informal knowledge about climate change within a household. Therefore, relevant knowledge such as knowledge required for adapting to climate-related in a city, will not be viewed as associated with only the knowledge generated by state disaster management institutions. Equally important is local knowledge of climate change in informal settlements.

Long (2004) therefore broadly views livelihoods (beyond economic activities), as the overall purpose of the negotiations and struggles over entitlements and access to resources in society.

Defining livelihoods Long opined that:

Livelihoods express the idea of individuals and groups striving to make an economic living, attempting to meet their various consumption and economic necessities, coping with uncertainties, responding to new opportunities, and choosing between different value positions (2004 p.54).

Overall, Long (1990) provides a major social theory of change and contributes to the ontology in research on vulnerability and adaptation practices. Therefore, in contrast to political ecologists', Long's (1990) ontology emphasises the need for incorporating the perceptions, views and knowledge of local actors when researching their vulnerability and adaptation practices.

However, despite the widespread application of actor-oriented theory in research on adaptive practices, the theory suffers a drawback as an only theoretical framing for contextualising the vulnerability analyses in informal settlements. For instance, Long (1990) does not articulate the dynamics between two of the domains (specifically, markets and state) such as why the state (and its local authorities) may resort to private sector-led development interventions in urban areas. Such interventions, as the privatisation of urban services of water and sanitation, also have ramifications for the wellbeing and vulnerability of residents of informal settlements to hazards.

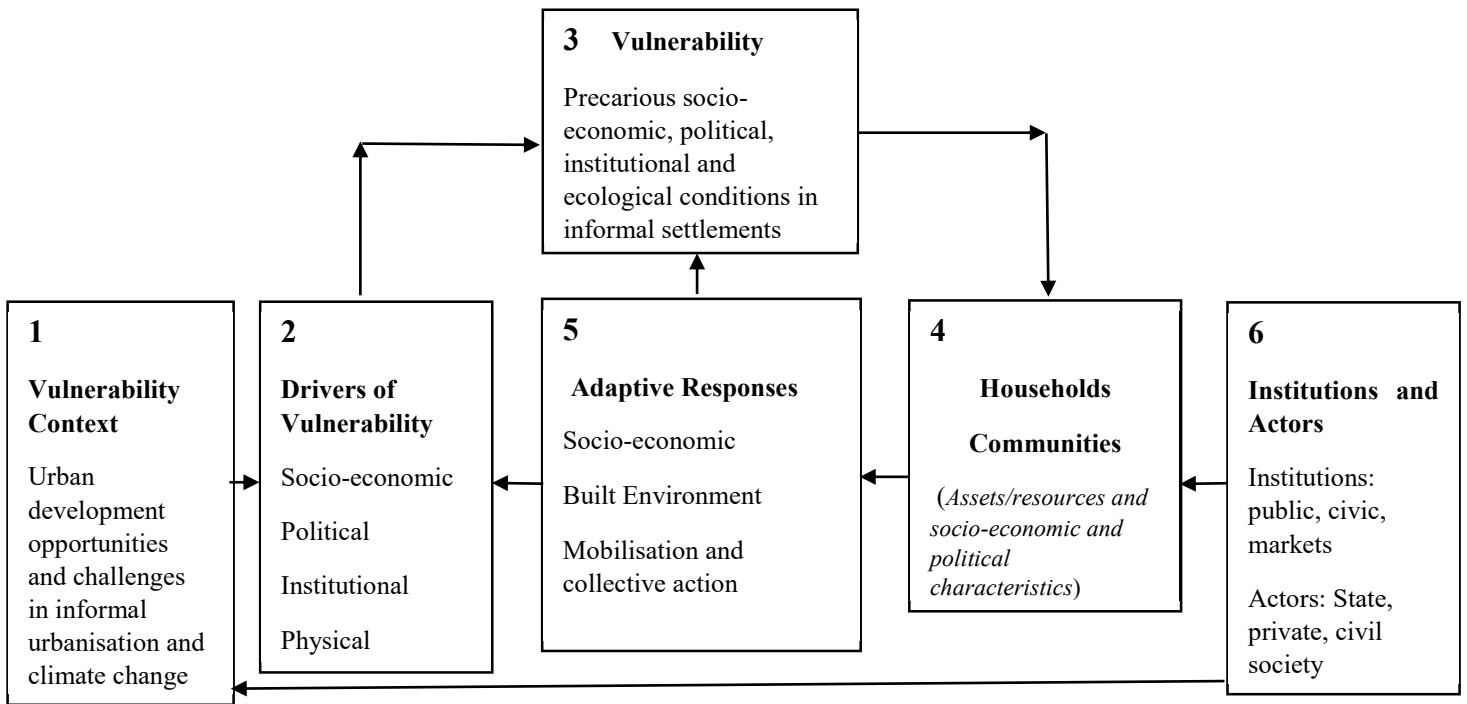
Recognising the limitations of political ecology frameworks and the actor-oriented theory, scholars such as Roy, Hulme and Jahan (2013), have proposed an integrated framework for analysing vulnerability and adaptive responses to climate change-related hazards. The framework which has been adapted for this study is presented in the next section.

3.6.3 Integrated Framework: Human Vulnerability and Adaptation to Climate

Change-related Hazards in Informal Settlements

The adapted framework incorporates a political ecology framework and actor-oriented theory, providing the theoretical underpinnings for examining both the drivers of vulnerability and adaptive responses to climate change/variability (shown in Figure 3.2). From political ecology, the drivers of peoples' vulnerability are socio-economic, political and institutional factors. These account for households' and communities' vulnerability to climate change-related hazards. On the other hand, from actor-oriented theory, residents of informal settlements are viewed as innovative individuals and households with knowledge, and whose abilities, preferences, aspirations, and struggles are reflected in the practices that they develop, including responding to climate change-related hazards. Thus, adaptive responses to vulnerabilities are categorised into three. First is 'socio-economic' strand in response to the socio-economic contextual vulnerabilities; while the second is 'built environment' climate change-related responses to their vulnerabilities to climate change on their built environments. The third component is 'mobilisation for collective political action' in response to both social contextual and climate-related vulnerabilities.

Figure 3.2: Theoretical Framework: Human Vulnerability and Adaptive Responses to Climate Change-Related Hazards in Informal Settlements



Source: Author's adaptation of Roy, Hulme, and Jahan (2013, p.159).

3.6.4 Component Description of the Theoretical Framework

The framework shown in Figure 3.2 is presented in six components. First, component numbered 1, is the vulnerability context and location. This involves cross-scale development-related opportunities and challenges, such as economic and political processes, as well as climate change/variability in a city varied across communities (Roy, Hulme and Jahan 2013). Thus, contextual economic, political and institutional factors underlie people's exposure to hazards.

Second is component numbered 2; the vulnerability domain and related factors which influence vulnerability for households in informal settlements to climate change. This comprises the socio-economic, political and institutional factors which influence/drive the vulnerability of residents of informal settlements to climate-related hazards, such as rising sea levels, excessive temperature, and flooding. Therefore, vulnerability, as an experience arises from the combination of climatic hazards and socio-economic, political and institutional contextual factors, depicted in component number 3. Moreover, a households' and communities' socio-ecological context include their socio-economic and political status as well as their levels of access to resources, as shown in component 4. Resources are contextual and complex and

dynamic bundle of financial, human, natural and social assets in a given place. Access to these resources by households which changes over time relate to their socio-demographic and political characteristics, including ethnicity, gender, and age. Included in these are human assets, such as individual's and households' knowledge of climate change/variability (Roy, Hulme and Jahan 2013).

Furthermore, actors in a city, who are active agents, have preferences and aspirations. These actors include households, community groupings, civil society and state/local authority (component 6). Moreover, actors are influenced by the prevailing institutions/rules and norms (both informal and formal), including rules on markets, especially the labour, land and housing markets. Therefore, institutions as the rules, regulations and norms influence the socio-economic and political context of residents of informal settlements and to climate-related hazards (Ostrom 2009).

Finally, as shown in component 5, adaptation practices are framed broadly in the context of 'adaptation as development'. This is influenced by households' or communities' abilities, preferences, aspirations, and struggles towards their wellbeing objectives (Roy, Hulme and Jahan 2013). Therefore, informal settlements' residents' responses may include both 'non-hazard' specific responses to socio-economic stressors and opportunities, including climate-related hazards such as flooding, excessive heat and storms. Moreover, the responses may also include responses to climate-related hazards in their built environments. On the other hand, a household's inability to take protective measures against climate change-related events may reduce their general well-being and increase their vulnerability to future climate change-related hazards.

3.7 Conclusion

This chapter covered definitions of key concepts of informal urbanisation, vulnerability, and adaptation in highlighting the conceptual boundaries of this study. It also examined the relevant empirical literature, showing the knowledge gaps as well presented the theoretical underpinnings and framework to contextualise the thesis. Specifically, an integrated political ecology and actor-oriented theoretical framework has been adapted to contextualise the analysis of vulnerability and adaptive responses to climate change-related hazards in informal settlements. In the next chapter, the methodology for carrying out this study is presented.

4 CHAPTER FOUR: RESEARCH METHODOLOGY AND STUDY CONTEXTS

4.1 Introduction

This chapter presents the research methodology as it was applied to answer the research questions in the study. The chapter has been divided into five main sections. The first section after this introduction is an engagement in debates on research paradigm, epistemology, and ontology, leading to a justification for situating this research within a pragmatist paradigm and a constructionist ontology. The second section explains the case study as the primary research design. Following section two, the choice of a mixed data collection and analysis methods and its justification is presented in the third section of this chapter. This section also covers the data requirements, sources and collection, as well as analytical methods in the study. Section four of the chapter covers the ethical considerations, which show how the research has complied with research ethics requirements. The final section of the chapter sheds light on the socio-ecological contexts of the study settlements/communities.

4.2 Research Paradigm, Epistemological and Ontological Positions

Current debates in social research often emphasise the need for researchers to adopt appropriate approaches, including their paradigmatic and ontological positions in research (Bryman 2015). Research paradigm is the ‘worldview’ that guides the researcher, not only in the choice of methods but the fundamental considerations of ontology and epistemology (Bryman 2015). This ‘world view’, as the researcher’s philosophical standpoint, tends to inform the choice of methods and hence underlies the overall logic of the research (Crotty 1998). While ontological thought is concerned with the philosophy of reality, epistemology addresses ‘how we come to know’ that reality (Krauss 2005). The overall process, research methodology, involves the strategy, plan of action, processes lying behind the choice and use of particular methods and the linkage of methods applied to the research outcomes (Crotty 1998).

On the other hand, research methods are the tools used for collecting and analysing data in addressing specific questions in the research (Bryman 2008). Thus, generally, a researcher’s epistemology and ontology are related to a research paradigm and overall methodology. As ontology, epistemology, and methodology are related, it is important to situate this research within an appropriate epistemological, ontological and methodological considerations. This is

essential since, a researcher's claim about knowledge of a phenomenon, often raises a question about how such a claim has arisen.

Three dominant paradigms that have guided social enquiry are positivism, interpretivism, and pragmatism (Bryman 2008; Creswell 2003). Positivism relies on a deterministic philosophy in which causes determine effects (Creswell 2003). Also, the theoretical perspective of positivism is objectivism (Crotty 1998). Therefore, positivists perceive phenomena as meaningful entities, existing independently of a researcher's experience that has truth and meaning residing in them as objects. Furthermore, positivists also contend that only careful and unbiased examination can attain that objective truth and meaning (Crotty 1998). In seeking the revelation of this truth, scholars of the positivist paradigm contend that the conduct of social research must be value-free of the researcher's (Bryman 2001). Doing so then requires the use of data collection tools that allow for the collection of evidence followed by rigorous analysis of this evidence to reveal the truth (Aliyu et al. 2014). For example, research conducted in the positivist paradigm may employ quantitative data collection methods such as survey, and quantitative data analysis technique of inferential statistics in analysing the data. Such research may also involve a series of activities such as modelling/prediction of relationships between dependent and independent variables. As a general principle, the interpretation of results of research conducted within the positivist paradigm tends to be limited to the outcome of the analysis, rather than based on the personal views and experiences of the researcher (Adams, Keane & Dutton 2005).

In contrast to the positivist philosophy of knowledge generation, the thrust in epistemological philosophy of interpretivism is that knowledge is established through meanings attached to the phenomenon by the researcher or research participants (Bryman 2016; Crotty 1998). This is based on the view that the social world in its uniqueness and complexities, requires a different approach to examination and understanding, rather than subjected to the same principles and procedures as in the natural sciences (Sarantakos 2012). Therefore, since research in the interpretivist paradigm focuses on the construction of meaning by the researcher/or participants, common methods often applied by interpretivists for gathering data include interviews, focus groups discussions, and review of documents (Arghode 2012). Data collected are often in the form of words, texts, and or pictures. However, as noted by Bryman (2016), the choice of data collection and analysis methods by a researcher per se does not indicate the

epistemological stance of the researcher, as some interpretivists also adopt the survey method for data collection.

A variant of the interpretivist paradigm is ‘critical inquiry’. Critical inquiry is an approach of research based on critical theory, which focuses on issues of power and dominative processes, within a social system (Kincheloe & McLaren 2002). As an example of a critical inquiry, a political ecologist may attribute the nature of vulnerability of residents of an informal settlement to the socio-economic and political processes of marginalisation within a city, linking this process to their vulnerability to flooding-related hazards. This is exemplified by the work of Pelling (1997) in George-Town (Guyana). Pelling (1997) argues that the vulnerability of residents of informal settlements to flood hazards is due to historical socio-economic and political processes that have marginalised them in the city.

Consistent with their worldview, the main ontological claim of ‘critical inquirists’ is subjectivism (Crotty 1998). Subjectivism asserts that constructing meaning on a phenomenon does not come out of an interplay between the subject and object. Rather, to ‘critical inquirists’ research is generally about interpretation, and meaning is imposed on the subject (a top-down ontology), so long as this conveys an understanding of the power dynamics and dominating relationships within a social system (Kincheloe & McLaren 2002). This ontological stance has often been viewed as biased and unscientific, by scholars of the positivist paradigm (Kincheloe and McLaren 2002).

A third paradigm, pragmatism, has sought to advocate for a shift away from the ‘so-called paradigm wars’ between positivism and interpretivism, towards a common ground of knowledge production. In contrast to the interpretivists and positivists, the pragmatists, claim a commitment to the research problem rather than a particular philosophical preference of knowledge production (Morgan 2007; Wheeldon & Ahlberg 2012). By focusing on the research problem, pragmatists may combine the reliability of empirical counts, as preferred by positivists, with the validity of a ‘lived experience’ of the research participants/or researcher, as preferred by interpretivists (Crotty 1998). Therefore, pragmatists tend to adopt data collection and analysis methods that are associated with both interpretivism and positivism, as was applied in this research.

The different paradigms, related epistemological and ontological standpoints discussed above, are linked to the different approaches that are often adopted by scholars in vulnerability studies,

resilience, and adaptation research. Although not always the case, it has been suggested that research in resilience, which involves measurements of system dynamics, has tended to be conducted within the positivist paradigm (Miller et al. 2010). Similarly, research on biophysical vulnerability, which involves quantification of biophysical climate-related hazards, has generally been conceived within the positivist paradigm (McLaughlin & Dietz 2008). This is in contrast to research in social vulnerability, which has always been conducted within constructionism (McLaughlin & Dietz 2008).

The framing of social vulnerability within constructionism has been informed by the desire of scholars in political ecology to offer explanations for the factors that underlie people's vulnerability to flooding hazards beyond simplistic quantifications (Aboagye 2012b; Cutter, Boruff & Shirley 2003; Pelling 2003). In so doing, this scholarship generally highlights how socio-economic, political and institutional factors underlie the vulnerability of urban dwellers to flood hazards, mainly from the perspectives of the scholars. Extending this approach, the scholars Isunju, Orach and Kemp (2015) have shown that, analysis of the drivers of vulnerability to flood hazards could involve the perspectives of the actors as their contextual experience. Doing so also involved the application of data collection and analytical methods that are associated with both the positivist and interpretivist paradigms.

Considering the debates in research paradigms and social vulnerability, this study hinges more on the pragmatist paradigm. Specifically, the study aims to examine the socio-economic, political and institutional context of residents of informal settlements and its influence on their vulnerability and adaptive responses to climate change-related hazards as a contextual experience in Accra. However, by analysing the drivers of vulnerability and adaptive responses to climate change-related hazards from the perspectives of both the actors and the researcher, this research is ontologically constructionist. Critical realists often adopt this combination of epistemological and ontological standpoints in environmental-related risks analyses (Oelofse 2003). As noted by Isunju, Orach and Kemp (2015),

critical realism assumes that while risks may be shaped by causal mechanisms of socio-economic and political factors, risk analysis requires examination of the local conditions that influence people's experience of vulnerability (p.277).

Therefore, this research is also methodologically critical realist.

4.3 Research Approach: Case Study

Case study approach has been associated with both positivist and interpretivist research paradigms. However, while cases are viewed as phenomena that exist to be revealed through empirical inquiry in the positivist paradigm, in the interpretivist paradigm, cases are constructed by researchers and research participants (Humphries 2008; Yin 2003). Yin (2009, p.17), defines case study as “*an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between a phenomenon and context are not clearly evident*”. Yin (2009)’s definition of cases includes “*events, individuals, organisations, processes, institutions, neighbourhoods and communities*” (Yin 2009 p.17), all of which constitute this present study.

Nevertheless, adoption of the case study approach in research has been critiqued by some scholars. Patton (2005), for example, has pointed out that a major critique of the case study approach, as applied by its practitioners is the inability of the method to generate generalisable findings. To Gerring (2006), a major point often raised by critiques of case study is that case study practitioners tend to adopt it to help them in finding evidence for validating their preconceived ideas. However, as noted by Yin (2003), much of the critique of the case study is based on a potential conflation of case study approach as a self-sustaining and/or complementary research design, with quasi-experimental studies. According to Yin (2003, p. 2), not only is the case study a form of research approach but that:

The distinctive need for case studies arises out of the desire to understand complex social phenomena because the case study method allows investigators to retain the holistic and meaningful characteristics of real-life events (p.2), as in this study.

A further justification of the case study approach is evident in its widespread adoption in disciplines such as sociology, political ecology, human geography, and generally in urban studies (Yin, 2009, p.4). For instance, over the period 1980 to 2008 the “*the frequency for case study research shows an upward trend in contrast to the other approaches*” in research (Yin 2013, p.xix). This approach becomes essential when questions of ‘how’ and ‘why’ of a phenomenon are being asked about contemporary events over which the investigator has little or no control (Yin 2009, p.13). In this case, the main research question initially posed by the researcher was: “*why does the socio-ecological context of residents of informal settlements in Accra take the present form, and how does this context influence their vulnerability and adaptive responses to climate change?*.” Nevertheless, case studies also investigate historical

events through the application of research tools of the historian such as “*interviews of persons involved*”, but also include other sources such as direct observation, which are beyond the “*the historian’s repertoire*” (Yin 2009, p.11). In this study, how residents of informal settlements become vulnerable (the drivers) to climate change-related hazards in Accra, arises out of both contemporary and historical socio-economic and political processes in Ghana.

Moreover, the relevance of the case study approach for examining the context of informal urbanisation processes in Accra, and other cities in Africa, has been underscored by scholars, such as Robinson (2006) and Watson (2013). Watson (2013) asserts that African cities present a valid empirical basis for the construction of or testing urban theory unique to their growth and development as cases. For Robinson (2006), the effective examination of the current urbanisation processes in cities in Africa will ideally require the use of flexible and innovative methodological approaches as cases. Such complexities include the combined processes of informal urbanisation and climate change, as in this present study.

Furthermore, the suitability of the case study approach in this study includes its flexibility to incorporate or be part of other research designs (Yin 1994; 2013). For instance, a case study can be part of or include other types of research designs, such as using the case study as the main approach, while integrating cross-sectional design to collect one-off data through household surveys (Yin 2013). In the context of this study, cross-sectional design through which quantitative data is often collected one time from households (Bryman 2006, 2015), has been incorporated into a case study design. Moreover, this research includes the collection of policy documents, as well as primary data from focus groups and key informant interviews, often viewed as elements of exploratory research design, as suggested by Ruane (2005). Further justification of the case study approach for research into vulnerability is the fact that risk and vulnerability, which are both place-specific phenomena, are best understood as cases (Ribot 2010). Overall, considering this ensuing discourse, the case study design is considered appropriate for this study as it seeks to examine the vulnerability and adaptive responses of residents of informal settlements to climate change-related hazards as a contextual experience in Accra. The study does so by applying a mix of qualitative and quantitative data collection and analysis methods as discussed next.

4.4 Justification for Adopting Mixed Qualitative and Quantitative Data Collection and Analysis Methods

It has been suggested by Bryman (2001) that, researchers' philosophical assumptions about the nature of reality, and how this should be examined, often influence how they formulate research questions, and the methods they adopt for collecting and analysing data. It is therefore not surprising that the different philosophical positions of positivism, interpretivism and pragmatism, are an integral part of the current debates on quantitative and qualitative research methods (Bryman 2008; Grix 2010; Krauss 2005; Neuman & Kreuger 2003a).

The scholars Neuman and Kreuger (2003 p.145), summarised the seven fundamental differences between qualitative and quantitative research. Firstly, while quantitative researchers tend to "*test hypotheses often determined at the beginning of the research*", qualitative researchers often "*discover meaning of the phenomenon once the researcher is immersed in the data*". The second suggested distinction between the two is in terms of the nature and role of concepts in research; "*concepts in quantitative research are often in the form of variables*", on the other hand, "*concepts are often in the form of themes*" in the case of qualitative research. Thirdly, concerning nature of measurement of the variables in research; "*measures are often created in a standardised manner before data collection*" in quantitative studies, while "*measures tend to be created in an ad-hoc manner specific to the individual researcher*" or research project in qualitative research. Fourthly, data collected is often in the form of "*precise measurements*" in quantitative research, while "*data collected is often in the form of words, texts, and pictures*" in qualitative research. Fifthly, while "*theory is largely causal and deductive*" in quantitative research, "*theory can be causal or non-causal but often inductive*" in qualitative research. Sixthly, the overall procedures adopted in quantitative research are often standardised, as replication is assumed.

On the other hand, the procedures often adopted in qualitative research are "particular", and replication rare. Finally, an analysis in quantitative research often "*proceeds by using statistics, tables and charts showing how the results relate to the hypotheses*", while analysis in qualitative research often "*proceeds by extracting themes in making generalisations*" (Neuman and Kreuger 2003 p.145).

Similar to the criteria highlighted by Neuman and Kreuger (2003), to Pernecky (2016), qualitative researchers reject the natural science models of truth; and in terms of procedures, prefer inductive (hypothesis-generating) research procedures over deductive (hypothesis-testing) procedures in their research. On the other hand, quantitative researchers often proceed from the generation of hypothesis, which is then tested through the collection of data (Pernecky 2016). Extending the role of hypothesis and the relationship between theory and the rest of the research, Wheeldon and Ahlberg (2012) suggest that, a test of hypothesis is usually based on a defined dependent and independent variable(s), determined before the data collection commences. In the context of this study, a dependent variable is the ‘perception of vulnerability’, while independent variables include a wide range of socio-economic and political characteristics of the household and their exposure to climate change-related hazards. Thus, the distinctions between the two groups of research focus on the philosophical stance of the researcher, and the nature of the research strategy adopted, relative to the relationship between theory/hypothesis and the other parts of a research process.

Extending, the debate on qualitative and quantitative research, Bryman (2012, p.35)’s position is similar to Neuman and Kreuger (2003) with respect to the nature of research and the relationship between research and theory. According to Bryman (2012, p.35), qualitative research is a research strategy in which: 1) *words rather than quantification, are emphasised*; 2) *involves an inductive approach to the relationship between theory and research*; and 3) *its adherents reject the practices and norms of positivism in their choice of data collection and analysis methods*. In contrast, quantitative research refers to a research strategy that: 1) *emphasises quantification in the collection and analysis of data using quantitative methods and techniques*; 2) *involves a deductive approach to the relationship between theory and research*; 3) *tends to involve the testing of hypothesis*; and 4) *embraces practices and norms of positivism* (Bryman 2012).

Nevertheless, Bryman (2012) avers that while many researchers associate qualitative research with the generation, rather than the testing of theories, there are many examples of studies in which qualitative researches have involved the testing of theories. This point is especially significant, given the distinctions between generic qualitative research approaches which involve generation of propositions, from the particular approach of grounded theory, which involves the generation of theory (Glaser & Strauss 2017).

It is therefore not surprising that Krauss (2005) reduces the distinctions between quantitative and qualitative research, to the philosophical position of the scholar. Asserting this point more clearly, Krauss (2005) avers that qualitative research is associated with the interpretivist epistemology, while quantitative research is associated with the positivist epistemology. Therefore to Krauss (2005), unlike Neuman and Kreuger (2003), the distinctions between the two are less about the nature of methods that a researcher may adopt for collecting and analysing data.

Debates on the distinctions between qualitative and quantitative research methods have also included views by scholars who have sought their common grounds in the form of a mixed methods research. Creswell and Creswell (2017) define mixed methods research as:

A research strategy with a philosophical assumption as well as methods of enquiry. As a strategy, it involves a philosophical assumption that guides the direction of data collection and analysis, and a mixture of qualitative and quantitative approaches in one or many phases of the research process. As a method, it focuses on collecting, analysing and mixing both quantitative and qualitative data in a single study or series of studies. Its central philosophical premise is that qualitative and quantitative approaches, in combination, provide a better understanding of the research questions than with either alone (p.17).

As a research approach, three main types of mixed methods design are described by Creswell (2017). The first which involves a balanced application of qualitative and quantitative methods simultaneously is convergence mixed methods. The other two involve application of more of either qualitative or quantitative methods than the other sequentially: it is either qualitative-quant or quantitative-qual depending on which precedes the other. It is in acknowledging the potential benefits from mixed-methods approaches that Grix (2010) suggests this as the most effective strategy for examining complex social phenomena, as in this study.

Nevertheless, to opponents of a mixed-methods strategy, there is not much to gain from combining methods associated with qualitative and quantitative research strategies in one research (Bryman 2015). Bryman (2015) summarises these opposing views on mixed methods in two-fold. The first stance of the debate revolves around ‘research methods’ and the second on ‘research paradigm’. Advocates of the ‘research methods’ stance contend that researchers do not just adopt methods for studies. Rather, their choice of methods is often guided by their disciplinary stance and preferences (Bryman 2012). On the other hand, advocates of the ‘research paradigm’, contend that quantitative and qualitative research methods are closely tied to positivist and interpretivist paradigms respectively and that it is inappropriate to confuse the

tools of the practitioners of the two (Bryman 2012). It is important to note, however, that the use of a structured questionnaire form of data collection, as applied in this study, does not necessarily mean a researcher's philosophical commitment to positivism. Similarly, as noted by Bryman (2012), the adoption of ethnographic-related methods of data collection by a researcher will not necessarily imply the researcher's commitment to interpretivism. Rather, as noted by Denzin (2012), the initial idea for blending qualitative and quantitative data collection methods was meant for 'methodological triangulation'.

By triangulation, the weaknesses of a given set of methods from either qualitative or quantitative research are addressed through the adoption of methods from the other (Creswell 2003; Creswell & Clark 2017). It is therefore not surprising that a close examination of social research over the last couple of decades shows that methods adopted by scholars have tended to 'free float', as mixed methods research strategies have become the dominant mode of social inquiry (Bryman 2012). Examining the drivers associated with the vulnerability of residents of informal settlements to flood hazards in Kampala (Uganda), the scholars Isunju, Orach and Kemp (2015) adopted a mixed-methods strategy.

Considering the debates in qualitative, quantitative and mixed methods research, this research also adopts a mix of qualitative and quantitative methods of data collection and analysis. This is crucial since neither qualitative nor quantitative data collection and analysis methods alone were deemed adequate for answering the research questions (shown in Table 4.1). Moreover, it has been suggested by Nardi (2018), that quantitative data collection methods become important when data in the form of values are required for particular variables. These become essential when research involves questions related to 'which of several variables', 'how much of given variables', or 'how many of given variables' require analysis. In the context of this research, the questions to be examined included 'which factors drive the vulnerability of the residents to climate change?' and 'what' of different phenomena, as shown in Table 4.1.

On the other hand, qualitative data collection methods become important when data in the form of words, texts and or pictures are needed in particular research (Denzin & Lincoln 1994; Taylor, Bogdan & DeVault 2015). These become essential when research involves questions relating to 'how' and 'why'? of a phenomenon, involving the need to elicit data from participants (Bryman 2012). In the context of this study, some questions sought to answer

‘who’ and ‘how’, of related variables, as shown in Table 4.1, as further discussed in section 4.5 of this chapter.

Table 4.1: Research Objectives, Questions and Data Collection Methods

Thesis objectives	Research questions	Sub-research questions	Data required	Data collection methods
1. Examine the factors that drive the vulnerability of residents of informal settlements to perceived climate change-related hazards as a ‘contextual experience’ in Accra	Which factors drive the vulnerability of residents of informal settlements to climate change-related hazards as a contextual experience?	Which social, economic, political and institutional factors influence the perceived vulnerability of residents of informal settlements, including to climate change-related hazards?	Social, economic, political characteristics, regulatory/legal barriers and physical factors; employment, access to labour and land markets, relation with employers, access to infrastructure and services, housing characteristics, community cohesion, awareness of building regulations, belonging to a group, access to community resources, nature of involvement in the governance of the city, exposure to climate change-related hazards.	Household survey, Focus groups; Institutional interviews; Collection of reports and policies; Photography; Observation.
		What are the most frequently experienced perceived climate change-related hazards among the residents of informal settlements?	Climate variability and change impacts: meteorological data, such as temperature and rainfall variability, effects of previous climate-related events.	Household survey, Institutional interviews
2. Assess the potential influences of the socio-economic context of the residents of informal settlements on their knowledge and capacity to respond to potential climate change in Accra	In which way does the context of residents of informal settlements influence their knowledge and ‘capacity to respond’ to potential climate change?	What are the perceptions of climate-related environmental changes among residents of informal settlements and the synergies with scientific knowledge on climate change-related phenomena?	Households’ knowledge of environmental changes and climate change; scientific data on climate change	Household survey; Focus groups; Interviews with state officials Photography; Observation.
		How do the socio-demographic characteristics of residents of informal settlements influence their knowledge of climate change and variability phenomena compared to the perspectives of state officials on the same?	Households’ knowledge of climate change and scientific data on climate change	Household survey; Interviews with state officials; Photography
		How does the socio-political context of residents of informal settlements influence their access to an early warning on climate change-related?	Households’ demographics and access to knowledge of climate change.	Household survey Focus groups;
3. Examine who adapts to what and why in the context of climate change-related hazards in informal settlements.	Who adapts to what and why in the context of climate change-related hazards in informal settlements?	What responses are adopted to address socio-economic contextual vulnerabilities in relation to climate change/variability	Types of economic adaptation responses by different households in relation to their social contextual and climate change-related hazards.	Household survey; livelihood/occupation/trade-related focus groups discussions
		How do socio-economic characteristics of residents of informal settlements relate to their adaptation options to climate change-related hazards in their built environment?	Adaptation options by various households to three major climate change-related hazards (flooding, excessive heat and storms).	Household survey
		What funding and/or support mechanisms are adopted for minimising social contextual and climate change-related vulnerabilities in the informal settlement?	Nature of institutional interventions and collective action in response to contextual and climate change impacts in the various communities.	Institutional interviews Household survey Collection of reports and policies Focus group discussions

Source: Author’s construct

4.5 Data Required

Collection of data in this research involved the use of tools from both quantitative and qualitative research realms. Firstly, to answer the first research question of: “Which factors drive the vulnerability of residents of informal settlements to climate change-related hazards as a ‘lived experience’?”, two related sub-questions were formulated. The first was “which social, economic, political and institutional factors influence the perceived vulnerability of residents of informal settlements to perceived climate change-related hazards?; and the second “what are the most frequently experienced perceived climate change-related hazards among the residents of informal settlements?”. Answering these questions, required data on households’ social, economic, and political characteristics; and the physical forms of exposure to climate change-related hazards. Collection of this data involved household surveys; focus group discussions with community leaders and leaders of trade-based groups. Also, key informant interviews with state and city officials involved in governance and climate change issues, were part of the data collection methods, as shown in Table 4.1. Furthermore, secondary data in the form of published works and reports were collected as further discussed in section 4.6.

Data needs and collection methods on the second research question: “In which way does the context of residents of informal settlements influence their knowledge and ‘capacity to respond’ to potential climate change?”, were similar to question one. Related sub-questions to this question were: 1) what are the perceptions of climate-related environmental changes among residents of informal settlements and the synergies with scientific knowledge on climate change-related phenomena? 2) how do socio-demographic characteristics of residents of informal settlements influence their knowledge of climate change and variability compared to the perspectives of state officials on the same? and 3) how does the socio-political context of residents of informal settlements influence their access to an early warning and ‘capacity to respond’ to climate change-related phenomena? Seeking answers to these questions required data on households’ knowledge of environmental changes; households’ and community’s knowledge of climate change and scientific data on climate change; households’ demographic information and knowledge of climate change; households’ main sources of access to climate change knowledge-related early warning information, as shown in Table 4.1. Collection of this data involved household surveys; focus group discussions with community leaders, and

key informant interviews with state and city officials involved in governance and climate change issues in Accra.

Finally, the data needs and collection methods for the third research question of this study: “Who adapts to what and why in the context of climate change-related hazards in informal settlements?”, were also similar to questions one and two. The related three sub-questions to this third question were: 1) what responses are adopted to address socio-economic contextual vulnerabilities concerning climate change/variability in informal settlements?; 2) how do socio-economic characteristics of residents of informal settlements relate to their adaptation options to climate change-related hazards in their built environment?; and 3) what institutional and collective responses are adopted as part of the funding/or support for addressing social contextual and climate change-related vulnerabilities in informal settlements?. Collection of this data involved household surveys; focus group discussions with community leaders and key informant interviews with state and city officials involved in governance and climate change issues in Accra, as shown in Table 4.1. Also, secondary data in the form of policies were collected on reports, the details of which are discussed further in section 4.6.

The collection of this data included conducting household surveys; focus group discussions with community leaders and key informant interviews with state and city officials involved in governance and climate change issues in Accra, as shown in Table 4.1. Moreover, secondary data in the form of policies were collected from reports and other publications, the details of which are discussed further in section 4.6.

Overall, the choice for a mix of qualitative and quantitative data collection and analysis methods in this study was meant to achieve the ‘logic of triangulation’ towards more valid conclusions. Doing so also enabled the researcher to collect data from a wide range of stakeholders and actors (state and non-state), hence, contributing to the validity of the findings of this study.

4.6 Data Collection Methods

Data collection in this study involved the use of semi-structured interviews to obtain data from the city and other government officials and community leaders. Focus group discussion guides were also used to collect data through focus groups meetings with community leaders and

leaders of trade groups, while household data were collected through household surveys in the four selected communities. On the other hand, through direct observation of the vulnerability and adaptive practices, photography, as well as document review, the researcher collected ethnographic-related data, as shown in Table 4.1. In this section, the various data collection methods applied in the study from both qualitative and quantitative realms are further discussed.

4.6.1 Qualitative Data Collection Methods

Qualitative research is research that focuses on “*the meanings, concepts, characteristics, symbols, and description of things*” not to their “*counts or measures*” (Berg & Lune 2007 p.3). It tends to focus on how individuals interpret their social world, and data collected is in the form of words or pictures, through methods such as focus group discussions, interviews, and non-participant observation (Neuman and Kreuger 2003). This study adopted several qualitative data collection methods in collecting data in the form of words and pictures, as discussed in this section.

4.6.1.1 Reconnaissance Visits

Reconnaissance visits involve a research team’s preliminary and brief visit to the research site before the actual research commences, often to familiarise with the study context (Bryman 2016). In this study, reconnaissance visits were undertaken in April 2017, during Ghana's main rainy season to the selected study settlements. The visits assisted the researcher in informing the key stakeholders about the research and in closely observing the nature of the socio-ecological conditions. This also enabled the researcher and data collection teams to discuss how survey participants were to be selected. Further, the visits provided a platform to traverse the various communities for mapping different aspects of the research-related phenomena, including delineation of community boundaries using Global Positioning System (GPS). Overall, the reconnaissance visits allowed the researcher and data collection assistants to familiarise with the community leaders, which proved helpful in selecting potential participants for the focus group discussions.

4.6.1.2 Focus Group Discussions

A focus group discussion is a qualitative data collection method in which several participants, discuss a particular defined topic, constructing meaning as a group (Bryman 2015; Krueger & Casey 2014). Focus groups are distinguished from group interviews, in that while focus groups are focused on discussions, that construct meaning on a phenomenon as a group and facilitated by a moderator, in the case of group interviews, questions are answered by members of the group as individuals (Bryman 2015; Krueger & Casey 2014; Litosseliti 2003). In this study, fourteen (14) focus group discussions were conducted involving community leaders and leaders of trade-based groups to determine their challenges and adaptive practices, as shown in Table 4.4.

Conducting focus groups discussions often involves the use of Focus Group Discussion Guides, as were developed and attached in Appendices 3 and 4. Development of the focus group discussion guide was influenced by the result of the literature review, which informed the research questions. The content of the focus group discussion guides was varied to address the specific data collection needs in the two categories of focus groups that were organised. In the category of general community focus groups, the focus group discussion guide covered the general community level perceptions and knowledge about climate change, and the vulnerability and adaptive responses of the four study communities. Overall, the general community focus groups were intended to collect community-level data and to provide details that could not be captured in the household survey.

On the other hand, the focus group discussion guide for the trade-based/economic sectors, captured their perceptions and knowledge, vulnerabilities and adaptive responses to climate change, as groups. Since Old Fadama and Adedenpko are not shoreline communities, focus group discussions for agriculture/fishing sector participants were not conducted in those case study communities. However, focus group meetings for the three trade groups (agriculture/fishing; crafts and industry; and trade/services) were organised in each of the two inland case study communities. Overall, the trade-based focus groups were conducted to collect data on economic activity-related themes which could not be captured in the household survey questionnaire.

Forming and conducting focus group meetings to collect data comes with a challenge, which requires a careful approach. Ritchie et al. (2013), have emphasised the need to ensure the representativeness of the group to avoid collecting data that is unrepresentative of the people studied. For Gill et al. (2008), choosing an optimal size of the group is important for achieving a successful focus group discussion, and this is suggested to range from six to twelve members. To select an optimal number while ensuring balance and representativeness of the participants, twelve community opinion leaders were selected for the general community focus groups. On the other hand, six leaders of trade groups were selected, for each trade-based focus group.

Selection of participants for the focus groups was purposive; the criteria involved leadership of each community and trade groups, men and women, as well as landlords (property owners) and tenants in each of the four settlements. The actual selection of members of focus groups was in consultation with community volunteers that supported in the data collection (administration of the questionnaire). This involved, compiling the lists and telephone numbers, and making initial telephone calls to the prospective participants, with follow up calls at least 24 hours before the commencement of the focus group meeting. Altogether, fourteen (14) focus groups were conducted, involving ninety-six (96) community members in the four case study communities (shown in Table 4.2).

Table 4.2: Focus Group Discussions in the Case Study Settlements

Case study settlement	Number of focus groups	Descriptions
Adedenpko	3	One general community focus group, and two sector-specific focus groups
Ga-Nshonaa	4	One general community focus group, and three sector-specific focus groups
Gbegbeyise	4	One general community focus group, and three sector-specific focus groups
Old Fadama	3	One general community focus group, and two sector-specific focus groups
Total number of focus groups	14	In all the four case study communities

Source: Author's fieldwork

Among other factors, a successful organisation of a focus group is associated with the choice of the meeting venue, the willingness of the participants to participate in the discussion and their language needs (Bryman 2012). According to Stewart and Shamdasani (2014), the proximity of the venue for focus group discussion is a key requirement for achieving optimal participation, when the research involves marginalised groups. In this study, focus group

meetings were conducted in the various communities, in locations determined suitable (such as a church, chief's palace, and school compound) in consultation with community leaders. To further ensure optimal participation, the meetings which were facilitated by the researcher and his field assistants were conducted in both English Language and the most commonly spoken local Ghanaian languages (in this case, Ga or Twi, depending on the community) in each settlement. The focus groups meetings lasted for about an hour of discussions, with short breaks in-between sessions, as advocated by Bryman (2012). These meetings were also audio recorded since audio-recording, allows the researcher to fully concentrate on moderating the discussion, as advocated by Ritchie et al. (2013).

4.6.1.3 Institutional (Key Informant) Interviews

Semi-structured interviews were carried out with leaders of institutions whose work relate to informal urbanisation and climate change. The institutions which were government departments/organisations, non-governmental organisations, and community-level institutions were sixteen (16) in number, involving twenty-five (25) key informants, as shown in Table 4.3.

Selection of the institutions and the key informant interviewees was purposive as only the institutions whose mandate related to informal urbanisation, and climate change governance was selected. Within these institutions, the actual interviewees were mostly the head of the institution or department, or his/her assigned, following their informed consent. The need for obtaining informed consent in the selection of prospective interviewees as a requirement for the ethical conduct of research has been highlighted by Crow et al. (2006). In this study, informed consent was obtained from all interviewees, after offering explanations of the purpose of the study, its benefits, time requirements, and potential risks posed to them.

The actual conduct of the interviews was through the aid of Interview Guides (samples, shown in Appendices 5, 6 and 7), and interviews were conducted mainly in the premises of the institutions. In doing this, the content of the Interview Guides, which were varied according to the institution, generally focused on different aspects of the research. They included the mandate of the institution, knowledge of climate change, and how the institution has influenced the vulnerability and adaptive responses of residents of informal settlements to climate change. The interviews which were conducted in the English Language often lasted for not more than an hour in each case. They were audio-recorded since audio-recording interviews allow the researcher to fully concentrate on the conversation, as suggested by Bryman (2012).

Table 4.3: Key informant institutional interviews and actors

	Institutions	Actor roles in climate change and informal urbanisation	Number of staff
1	National Disaster Management Organization (NADMO)	Implementation and disaster relief response	3
2	Town and Country Planning Department (TCPD)	Physical planning and development control	2
3	Environmental Protection Agency (EPA)	Research, enforcement of environmental laws and regulations	1
4	Ghana Meteorological Agency (GMA)	Generation of climate data, research, and communication	2
5	Accra Metropolitan Assembly (AMA)	Overall development of Accra	4
6	Ministry of Environment, Science and Technology (MEST)	Policy formulation, monitoring, and evaluation of environmental issues	1
7	Ministry of Local Government and Rural Development (MLGRD)	Policy formulation, monitoring, and evaluation of urban development issues	1
8	Asiedu Keteke Sub-metropolitan District Council	Implementation of development interventions, enforcing environmental bye-laws and development control	2
9	Gamashie Development Agency (GAMADA)	Coordinating development interventions in the Gamashie Area	1
10	People's Dialogue on Human Settlement (PD)	Capacity building of informal dwellers and traders, education, sensitisation and advocacy	1
11	Ghana Federation of the Urban Poor (GHAFUP)	Capacity building of informal dwellers and traders, education, sensitisation and advocacy	1
12	Global Communities	Capacity building of informal dwellers and traders, education, sensitisation and advocacy	1
13	The traditional ruler of Gbegbeyise	Land management	1
14	Old Fadama Development Association	Community mobilisation and advocacy in Old Fadama	2
15	Paradeso Youth Club	Community mobilisation	1
16	Gamashie Slum Upgrading Facility	Funding slum upgrade in Gamashie	1
	Total number of interviews		25

Source: Author's fieldwork

4.6.1.4 Review of Secondary Sources of Data

Situating this research in the appropriate context, over three hundred academic sources, policy documents and reports were reviewed, as part of the qualitative data collection process. Hart (2018) has suggested important points to note in the review of the literature. Important areas include noting the debates, especially 1) why the phenomenon under investigation is essential; 2) how scholars have addressed the challenge, including the theoretical frameworks and methods they applied; and 3) what remains to be known and why?. In the context of this study, the review of academic documents (journal articles, books, and theses) covered the subjects of informal urbanisation, vulnerability, and adaptation to climate change. Resulting from this review is the research gap, as well as appropriate knowledge for the development of the

research questions. The review has also been useful for subsequent discussion and contextualisation of the findings of this study.

Moreover, the review of secondary sources, which involved published works, such as Abeka (2014), Appeaning Addo and Adeyemi (2013), Amoako (2015), CORHE (2004) and Grant (2006; 2009) assisted in highlighting the context of informal urbanisation, climate change, urban governance in Accra. In addition to published work, documents reviewed included relevant government policy frameworks, such as Ghana’s Environmental Policy Framework, Ghana’s National Urban Policy Framework, the Participatory Slum Upgrading and Prevention Strategy, and National Climate Change Adaptation Strategy, as shown in Table 4.4. Overall, this review assisted the researcher in determining the official positions of the state and its city authorities on urban informality, vulnerability and adaptive responses to climate change in the Accra Metropolitan Area.

Table 4.4: Policy documents collected during institutional interviews

Documents collected	Source Institution
Accra Participatory Slum Upgrading and Prevention Strategy	AMA
Accra Metropolitan Assembly Medium Term Development Plan	AMA
Greater Accra Metropolitan Area Strategic Plan	AMA
National Urban Policy Framework - 2012	MLGRD
Ghana National Urban Policy Action Plan - 2012	MLGRD
Draft National Slum Upgrading and Prevention Strategy	MLGRD
Ghana Housing Policy	MLGRD
National Riparian and Buffer Policy	MLGRD
National Building Regulations	MLGRD
National Climate Change Policy	MESTI
National Climate Change Adaptation Strategy	MESTI

Source: Author's fieldwork

4.6.1.5 Non-participant Observations and Photography

Data collection in this study included visits to the communities, non-participant observations and photography, at different stages in the data collection process. As a qualitative data collection method, non-participant observations involve a researcher observing, without taking part in the activities related to the phenomenon that is being observed (Denzin & Lincoln 1994). In this case, it was necessary for the researcher to observe how communities carried out cleaning up activities such as unclogging their drains, as this has an impact on the occurrence of floods. Also, the observation method was necessary to support the reported impacts of

climate change-related hazards such as coastal erosion and floods, during focus group meetings. Furthermore, an observation was important in documenting the ethnographic settings of each community, and the physical evidence of households' responses to the general stressors and shocks they faced. Overall, non-participant observation and photography were necessary to produce evidence of the ethnographic settings of the participants, assisting in shedding light on the socio-ecological contexts of the respondents in this study.

4.6.2 Quantitative Data Collection Method

Quantitative data collection methods become essential when data in the form of values or numbers are needed for analysing particular variables and when a researcher is interested in determining relationships among given variables (Creswell & Clark 2017). A dominant quantitative data collection method is a questionnaire-based survey (Bryman 2012). Since this study involved the determination of relationships between several variables, the use of a survey was required.

4.6.2.1 Household Survey

A household survey method of data collection was adopted since the main unit of inquiry in this study is the household. Fink (2015) has suggested that the nature of the research objectives, the level of literacy of the potential respondents, and the researcher's ability to personally administer the questionnaire, are important factors in determining whether to adopt a researcher-led survey or self-administered survey. To Bryman (2002), a major consideration in deciding on the survey method is the level of literacy of the potential respondents. In the context of this study, a researcher-led survey, through face-to-face interviews was considered appropriate, given the expected lower levels of literacy of the residents of informal settlements.

Design of the structured questionnaire, took into consideration three important principles as recommended by Neuman and Krueger (2003). This involved ensuring clarity of the content, by keeping the questions relevant, simple and clear; avoidance of leading questions which can potentially bias respondents' answers; and ensuring a logical ordering of the questions to achieve coherence and ease of responses during administration. Further, the design of the questionnaire included mostly closed-ended, few partially open-ended and much fewer open-ended questions, for two main reasons. First, this was intended to allow the researcher to collect as much data that could be easily aggregated within a short period through closed-ended

questions. Nevertheless, the potential biases associated with using a questionnaire of only pre-coded questions, which restrict respondents' in their responses, has been noted by Bryman (2002). Therefore, the inclusion of the response option of 'other', provided an opportunity for respondents in this study to provide their answers to questions beyond the pre-coded options. On the other hand, the inclusion of open-ended questions allowed the interviewers to probe further through the use of follow-up questions. Lewin (2005) suggests that doing so often reveals the respondents' reasoning for providing certain answers to pre-coded questions.

Moreover, the ordering of the questionnaire was structured into related themes, including experience with environmental and climate change effects, adaptive responses to climate change (Appendix 2), to achieve coherence during interviews. Furthermore, the inclusion of filter questions allowed the respondents to respond to only relevant questions and within a shorter period.

Once designed, the need for testing a new questionnaire has been emphasised by Fink (2015). He asserts that testing of a questionnaire is crucial in survey research, as it helps in ensuring the relevance of research questions and achieving a better understanding of the questions by the respondents. In the context of this study, testing of questionnaires was conducted in a comparable similar settlement/community (Chorko), which was not part of this study. This allowed the researcher to observe how data collectors administered the questionnaire and determining the average duration of the interview sessions. Together with the preliminary results from initial focus group discussions, results from the pilot survey assisted the researcher to fine-tune some of the response options to the questions. Overall, this pilot survey assisted in enhancing the quality of the questionnaire and minimising the collection of unwanted information.

To optimise community participation in this study, as well as address concerns of potential security threats to data collection assistants, community members who were literate in English, Language, were recruited as field assistants. Bryman (2012) has emphasised the importance of training and supervising such data collection assistants, whenever a researcher uses their services. Developing this point further, he suggests that, it is useful for the training of data collection assistants to include how they will contact prospective respondents, read out questions, adopt an appropriate probing style, and record interviews to prevent biasing the respondent's answers (Bryman 2012). In this study, half a day's training session was organised

for the field assistants. This covered how to contact prospective respondents, read out questions, adopt an appropriate style of probing, and record interviews. Following the training of the data collection assistants, administration of the questionnaire was conducted mainly in the English Language, augmented with the predominantly spoken local Ghanaian languages of 'Ga' and 'twi' as needed.

4.7 The Sampling and Participant Recruitment Strategies

A multiplicity of sampling methods were adopted in this study, given the different layers of units of data collection (households, groups, communities, and institutions). Since the study sought to examine the factors influencing the vulnerability and adaptive responses of residents of informal settlements to climate change-related hazards in Accra, the primary sampling involved the selection of case study settlements. Yin (2013), suggests that the selection of cases should always take into consideration 'the representativeness' of the phenomenon under study. On the other hand, Levy and Lemeshow (2013), suggest that regardless of the type of research design, probability sampling is more ideal when research involves the need for statistical analysis to establish relations between socio-economic variables of households. Bertrand, Duflo and Mullainathan (2004), further offer two conditions that warrant cluster sampling of households, as an ideal sampling method in contexts as in informal settlements in a city. The first is when there is no sufficient data to allow for easy development of sampling frames on the phenomenon under investigation, and second when the study population involves mutually homogenous yet internally heterogeneous groupings.

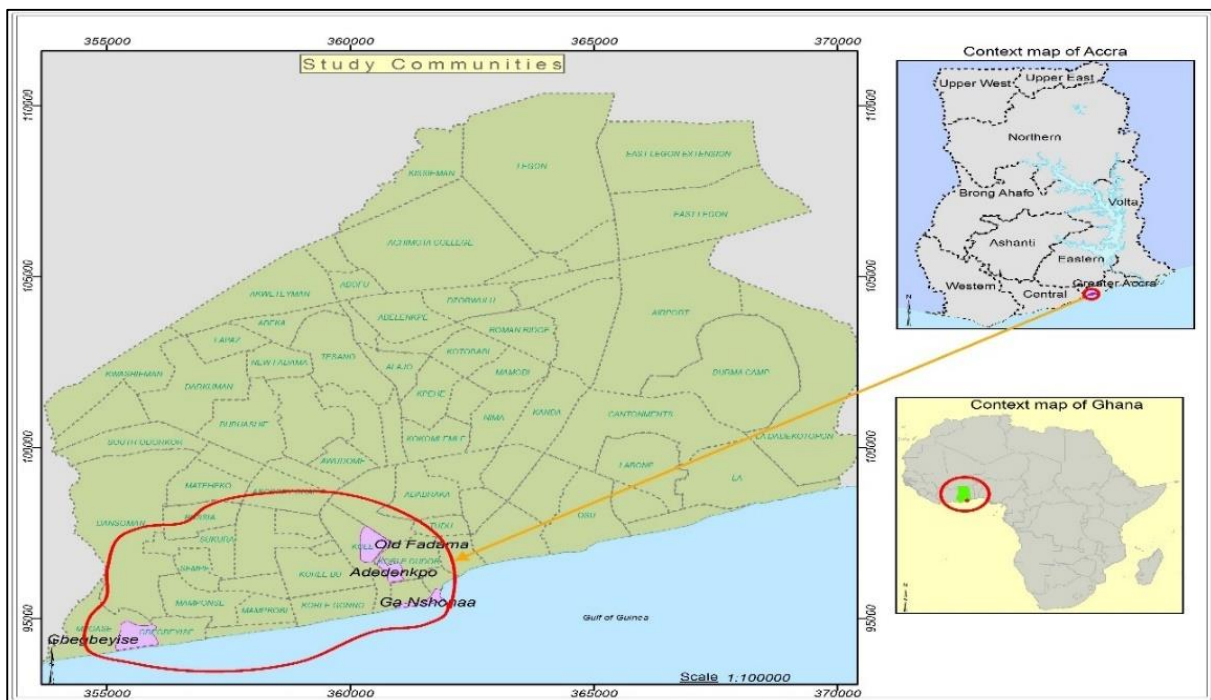
Considering the above discourse, a multi-stage cluster sampling approach was considered appropriate to select samples at household level following purposive sampling of the case study settlements. The first stage of this involved the selection of the case study settlements, using three-factor selection criteria. The first criterion is 'the informality of the settlement' based on a mix of land ownership patterns. Second, is informal settlements whose residents were affected by the different impacts of climate change, and third is whether such a settlement was located inland or on the shoreline of Accra. Selection of these settlements was conducted with the aid of a map and list of informal settlements on Accra (see, AMA & UN-HABITAT 2011). Resulting from this, four settlements representing the four different cases of informal urbanisation under conditions of climate change were selected as Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama, as shown in Table 4.5 and Figure 4.1.

Table 4.5: Selection of the Case Study Settlements

Name of study settlement	Main characteristics of the case study settlement
Adedenpko	Predominantly land owner-occupied /non-squatters, few squatters, located inland
Gbegbeyise	Predominantly land owner-occupied /non-squatters, located on the shoreline/coastline
Ga-Nshonaa	Squatters, located on the shoreline/coastline
Old Fadama	Squatters, located inland

Source: Author’s construct based on AMA & UN-HABITAT (2011)

Figure 4.1: Location of the Selected Case Study Settlements in Accra



Source: Author’s construct based on maps from AMA (2014)

The second stage of sampling involved the determination of sample size and selection of the sample units (households) in each case study settlement. This involved the determination of the total number of households in each of the four study settlements, using data obtained from varied sources. Data for Adedenpko and Gbegbeyise were obtained from the Accra Metropolitan Assembly (AMA 2014). However, in the case of Ga-Nshonaa, an approximation of the number of households was conducted with the aid of maps and other community records, before the household survey commenced (Table 4.6). Overall, the number of households for each case study community was therefore approximated. Scholars such as Isunju, Orach, and

Kemp (2015) justified the approximation of such population given the often-cited challenge in obtaining uniform and up-to-date data on informal settlements.

Achieving a reasonable level of representativeness within given resource constraints is important in survey-related academic research since this influences the quality of the conclusions drawn thereof. To achieve a reasonable sample size in each case study settlement, a formula found in Cochran (1977), was adopted for application.

This is summarised as $n = \frac{Z^2 \times p(1-p)/(\alpha)^2}{1 + (Z^2 \times p(1-p)/(\alpha)^2 N)}$, where Z = z-score for a given Confidence level; p =proportion of the population in the expected outcome, often considered at 50 percent to maximise the sample, where no known proportions are involved. Also, α is the margin of error and N , the estimated population (households in this case) (Cochran 1977). Applying this formula, which is recommended for stratified samples, sample sizes for each case study settlement were determined at a margin of error of 0.08 and 95 percent confidence level. This resulted in a total of 582 households, as presented in Table 4.6.

Table 4.6: Sample Population of the Case Study Settlement

Study Settlement	Estimated/available total number of people	Household size (No. of persons/ household)	Approximated number of households	Size of the sample (Nos. of households)	A margin of error at a 95 percent confidence level
Adedenpko	32,340	3.3	9,800	148	0.08
Ga-Nshonaa	5,001	3	1,667	138	0.08
Gbegbeyise	13,349	2.7	4,944	146	0.08
Old Fadama	81,325	2.2	36,966	150	0.08

Source: Author's construct

Crucial for ensuring the representativeness of study samples, is the nature of the distribution of the sampling units among the population (Fink 2015; Levy & Lemeshow 2013). It has been suggested that sampling through clustering, can be made more representative of the population if principles of systematic sampling, are integrated into the distribution process (Lohr 2009). In the context of this study, each community was divided into sections/zones with the aid of aerial photos, and sample intervals were determined for each community to ensure representativeness in the distribution of the sample, as was done by Cissé & Sèye 2015 in Dakar (Senegal).

A systematic selection of households was then carried out based on set criteria for household survey respondents. Potential survey participants were required to be at least 18 years old, resident in the selected community and head of the household. The recruitment process then

involved the identification of a potential household and securing their informed consent. Initially selected households who were unavailable to participate in the data collection were replaced with the next available households. Overall, the systematic selection of households was carried out in the various zones in each community until the estimated sample was realised.

Sampling for key informant interviewees and focus group discussants was also based on purposive sampling; based on defined criteria, and the informed consent of the participants. In this study, institutions whose mandate related to informal urbanisation and climate change governance, at community, city and national levels were selected automatically. Key informants in each institution were determined, through multiple processes such as finding out from the websites of the institutions and enquiring directly from the community. Identified prospective interviewees were then sent a participant information sheet to inform them about the research and their potential role, as well as the associated risks and time requirements for their participation. Following this, the interviewees' approval to participate in the interview was also sought by obtaining their informed consent before commencement of the actual interview.

Similar to sampling for interviews, sampling for focus group discussions were also purposive; based on defined criteria as well as informed consent. In this study, the criterion for the general focus discussions was a mix of opinion leaders who are a mix of landlords, tenants, men, women, and youth. On the other hand, the criteria for selecting discussants in a trade-based focus group discussion was opinion leaders engaged in fishing and agriculture sector; trade and commerce and crafts and industry in each community. Therefore, the selection of participants of the focus group discussions was through consultations with community leaders and Research Assistants.

4.8 Data Quality Checks

Data quality checks which require that research data is checked for completeness, accuracy and consistency are very important to avoid data collection errors (Bryman 2015). In this study, completed data collection instruments were numbered to make it easy for identification and to check for completeness, accuracy, and consistency of the responses.

4.9 Data Analysis

Data analysis in this study involved a mix of quantitative and qualitative data analysis techniques based on the needs of the research questions. Before the commencement of analysis,

data from the four selected informal settlements were grouped separately from data collected from institutions. This categorisation prevented the mix of data from the two sources, and for the researcher to more reflect on the different possible analytical techniques of each group of data sets, as discussed in this section.

4.9.1 Analysis of the Quantitative Data

Analysis of quantitative data involved statistical analysis using the Statistical Package for Social Sciences (SPSS) Version 24. Upon completion of entry and cleaning up of the data, several variables were also re-categorised, to allow for more detailed and easily manageable analysis of the data. Further, several computer-aided analytical procedures were then conducted, based on the needs of the research questions, including a simple descriptive analysis of frequency counts and cross-tabulation of various variables. For instance, analysis of socio-economic and political variables of the households' vulnerability and economic-related adaptive responses, was through simple tabulations, frequency counts and cross-tabulations.

In general, further inferential analysis of quantitative data often includes inferential statistics in establishing association/relationships between variables, beyond what is possible to achieve through a cross-tabulation of the variables (Norušis 2006). In this study, bivariate logistics regression analyses were conducted to assess the relationships between different dependent variables and groups of independent variables, in answering the three main research questions in this study. Hair et al. (2006), suggest that binary logistic regression analysis is appropriate when the following assumptions are met; (1) there are more than two independent variables and a dichotomous dependent variable; (2) the research involves a sample size of a minimum of sixty. In the context of this study, the first assumption by Hair et al. (2006) is met since the outcome variable/dependent variable is dichotomous and the outcomes are mutually exclusive of each other and independent. As shown in the questionnaire (Appendix 2), the dependent variable for the perception of vulnerability has two responses as 'vulnerable' and 'not vulnerable' as the outcomes. Similarly, the dependent variable for structural adaptive response has the responses as 'took action', and 'did not take action' as the outcomes.

The second requirement for binary logistics regression is met in this study since the predictors/independent variables are more than two. In this case, the predictors include household characteristics such as age, ethnicity, gender, income, and belonging to a group.

Finally, the third requirement for binary logistics regression is met in this study, since the sample size for each community is more than sixty (totalling 582 households).

Therefore, binary logistics regression analyses were conducted to determine the drivers of vulnerability to climate change-related hazards, in response to question one of the thesis. Similarly, the analysis of the adaptive responses to multiple climate change-related hazards, in answering the third thesis research question involved the application of binary logistics regression analysis.

The application of binary logistics regression in this study involved the generation of odds ratios. An odds ratio is a measure of association between an exposure and an outcome, related to the dependent and independent variables (Bland & Altman 2000). In simple terms, the odds ratio represents the odds that an outcome will occur given a particular exposure to a household; such as the odds that a household will perceive itself as vulnerable to climate change-related hazards given their exposure to ‘threats of eviction’ and ‘climate change-related hazards’. This is often interpreted in comparison with the odds of the outcome occurring in the absence of that exposure. Similarly, the generation of odds ratios in relation to adaptation was to determine that, a household will take an adaptive action given their exposure to several factors such as ‘threats of eviction’; interpreted in comparison with the odds of the household taking action on climate change-related hazard without ‘threats of eviction’.

Overall, the application of binary logistics regression in determining the association between socio-economic and political factors (drivers) of perceived vulnerability in this study is supported by previous scholarly works conducted in similar contexts. For instance, Isunju, Orach, and Kemp (2015) in determining the association between the drivers of the vulnerability of residents of informal settlements in Kampala (Uganda) to flood hazards, conducted binary logistics regression analysis. Similarly, Abeka (2014) applied binary logistics regression analyses in determining the factors associated with a household’s adaptive responses to flood hazards in three informal settlements in Accra (Ghana).

4.9.2 Analysis of the Qualitative Data

It has been suggested by Creswell (2013) that the most preferred method of qualitative data analysis is grounded theory since it provides the theoretical underpinning for studying knowledge, attitudes and practices about social phenomena. Research using grounded theory typically begins with a question or the collection of qualitative data. Collected data is reviewed, and as repeated ideas, concepts or elements become apparent, they are coded. Collection of

more data is then followed by a re-review and regrouping of codes into concepts, and then into categories, forming the basis for a new theory (Glaser & Strauss 2017). A reference to grounded theory in this thesis does not mean this was fully applied in the analysis. In this study, a theoretical proposition was made, that a suite of socio-economic, political and institutional factors may have influenced the vulnerability of residents of informal settlements to climate change-related hazards as a contextual experience in Accra. Collection and analysis of data in this study then sought to examine the reality from the perspectives of the actors in the context of Accra.

Analysis of the qualitative data involved manual coding of the data, generation of themes and sub-themes about the vulnerabilities and adaptive responses of the respondents. Coding helps to sort out data according to categories (Glaser & Strauss 2017). The coding in this study revolved around the different research questions and theoretical framework in three main ways. First, coding for research question one focused on socio-economic, political and institutional factors, knowledge of climate change and the impacts of climate change-related hazards. Secondly, coding related to question two involved the perceptions, knowledge, and experiences of climate change and the household's capacity to respond. Finally, for question three, the coding related to socio-economic responses about climate change, hazard-specific responses as well as collective actions on climate change vulnerabilities.

Coding the data required that, interview and focus group data had to be transformed into transcripts, added to field notes of the researcher, arranged for each community and institution. Together with the transcripts, the notes from the key informant interviews were first read through to gain a first level appreciation of the research findings, paying attention to each institution, its role and working relationship with residents of informal settlements relative to their vulnerability and adaptive responses. This process proved useful in subsequent selection of quotes from the interviews and focus group discussions on supporting the results of the household surveys. Moreover, the examination of the transcripts from focus group discussions shed light on the vulnerability and adaptive responses of the community members. Overall, the continuous and iterative process of examination of the qualitative data allowed for the identification of patterns, matching similar patterns by grouping similar ideas into coherent themes to interpret the texts. On the other hand, analysis of photographs was through physical

examination, finding the relevant photographs for the relevant theme. Results of this analysis have been presented in Chapters Five, Six and Seven of this thesis.

Similarly, analysis of documents involved a thematic review, noting the complementing or contrasting positions of the different sections of the documents relative to themes. The themes were manually generated, mostly after the first reading of each text/document. Altogether, findings based on the analytical methods adopted in this study (shown in Table 4.6), have been presented in Chapters Two, Three, Five, Six and Seven of the thesis.

Table 4.7: Categories of Data, Sources and Methods of Analysis

Category of data	The main source of data	Method of analysis
Community-level data	Household surveys	Tabulation and frequency count, cross-tabulation, simple descriptive statistics analysis, and binary logistics regression analysis, showing relationships and patterns.
	Focus group discussions	Coding of responses under relevant themes, and thematic analysis
	Key informant interviews	Coding of responses under relevant themes, and thematic analysis
	Photographs	Supporting chapter discussions with photos and explaining
Data from state institutions	Key informant interviews	Coding of responses under relevant themes, and thematic analysis
	Quantitative data on Climate Change-related variables	Tabulation and frequency counts, and charts, showing relationships and patterns.
Documents; Institutional reports, media, academic work and reports	Documents; academic, policies, legislation, and grey material,	Document analysis through thematic review.

Source: Author's construct

4.10 Measures Relating to Research Validity and Reliability

Research validity is crucial; since that determines the extent to which the findings can be relied upon (Bryman 2016; Creswell & Clark 2017). To ensure the validity of the findings of this research, several methods were triangulated to cross-check information gathered from the various sources, as discussed in sections 4.6 and 4.9. Furthermore, construct validity was improved through pilot testing the data collection instruments in this study. Moreover, in optimising the reliability of the research findings, a mini-workshop of fifteen (15) representatives from stakeholders, lasting for about an hour, was organised in August 2018 in Accra. The participants who were representatives from each case study community and local authority validated the preliminary findings. Overall, no major issues were noted from this validation workshop to have adversely influenced the outcome of this study.

4.11 Ethical Requirements and Considerations

This study was conducted in fulfilment of the requirements of the Australian Code for the Responsible Conduct of Research. First of all, approval from the Human Research Ethics Committee (HREC) of the University of Technology Sydney was obtained. The application for ethics approval in this study involved clarifying how the research will be conducted ethically. Upon obtaining approval from the Human Research Ethics Committee, necessary ethical conduct requirements were complied with in this research. These related to confidentiality in the collection and management of data, noting and reducing exposure of project participants to risks, and management of issues of conflict of interest, as discussed in this section.

4.11.1 Confidentiality on Participants

Confidentiality of research participant data is an essential requirement for the ethical conduct of research; since research, participants have to be treated with respect, and data collected on them concerns their privacy (Alderson & Morrow 2011). In ensuring confidentiality in the ethical conduct of research, names of participants were not obtained by the researcher in this study. Also, the presentation of data in this study in ensuring the anonymity of participants used generic labels/references to participants, when their quotes are used in the text, for instance, in consonance with the signed Informed Consent Forms by the participants. Furthermore, the recording of interviews with participants was always preceded by obtaining their informed consent.

4.11.2 Risks to Participants

The need for noting and reducing risks to human subjects is also a requirement for ethical research (Rid, Emanuel & Wendler 2010). In this study, two minor risks related to inconvenience and discomfort to participants were identified and addressed. First was a risk of possible inconvenience from some of the participants, who may be critical of their organisations during interviews. In response this risk, attention was paid to key informants in certain organisations who may have felt uncomfortable disclosing information regarding their organisations, assuring them of arrangements to ensure the anonymity and confidentiality of the data gathered.

The second risk related to the potential impact of the different power dynamics in the various communities. It was possible that people with less power may have felt uncomfortable

expressing their views, which may be critical of authorities. To address this risk, issues related to conflicts among community members were sought from key informants and avoided at focus group discussions. At all times, participants were also reassured that they did not have to answer any questions they were not comfortable with and that they could withdraw from the research process at any time.

4.11.3 Declaration of Pre-existing Relationships

Acknowledging pre-existing relations between researchers and research subjects is important in the ethical conduct of research since a pre-existing relationship may bias a researcher's conclusions on the subject (Bryman 2012). In the context of this study, the researcher has led project teams to work directly in some of these study communities, delivering capacity building training to community-based organisations. As a result, some of the community volunteers and community leaders were known to the researcher. However, care was taken, for familiarity with such leaders not to affect this research in any way as to inconvenience either side or negatively influence the conclusions in this study. Nevertheless, the researcher's knowledge about the study communities was substantially beneficial in the data collection process.

4.11.4 Special Attention to Native Communities

The need to pay attention to native communities, recognising their norms and cultural practices by researchers, is a critical component of the responsible conduct of research, as spelled out in the Australian Code for the Responsible Conduct of Research (NHMRC 2007). In this study, research participants were accorded the needed respect and protection, benefitting from the researcher's previous experience working with slum communities. For instance, in acknowledging local cultural values, introductory meetings with traditional rulers and key community leaders were conducted to pay respect while informing them about this research. Also, being aware of the taboos in the communities, as an example related to a ban on fishing activities on Tuesdays, no interviews were organised with fisher folks on those days.

4.12 Study Challenges and Limitations

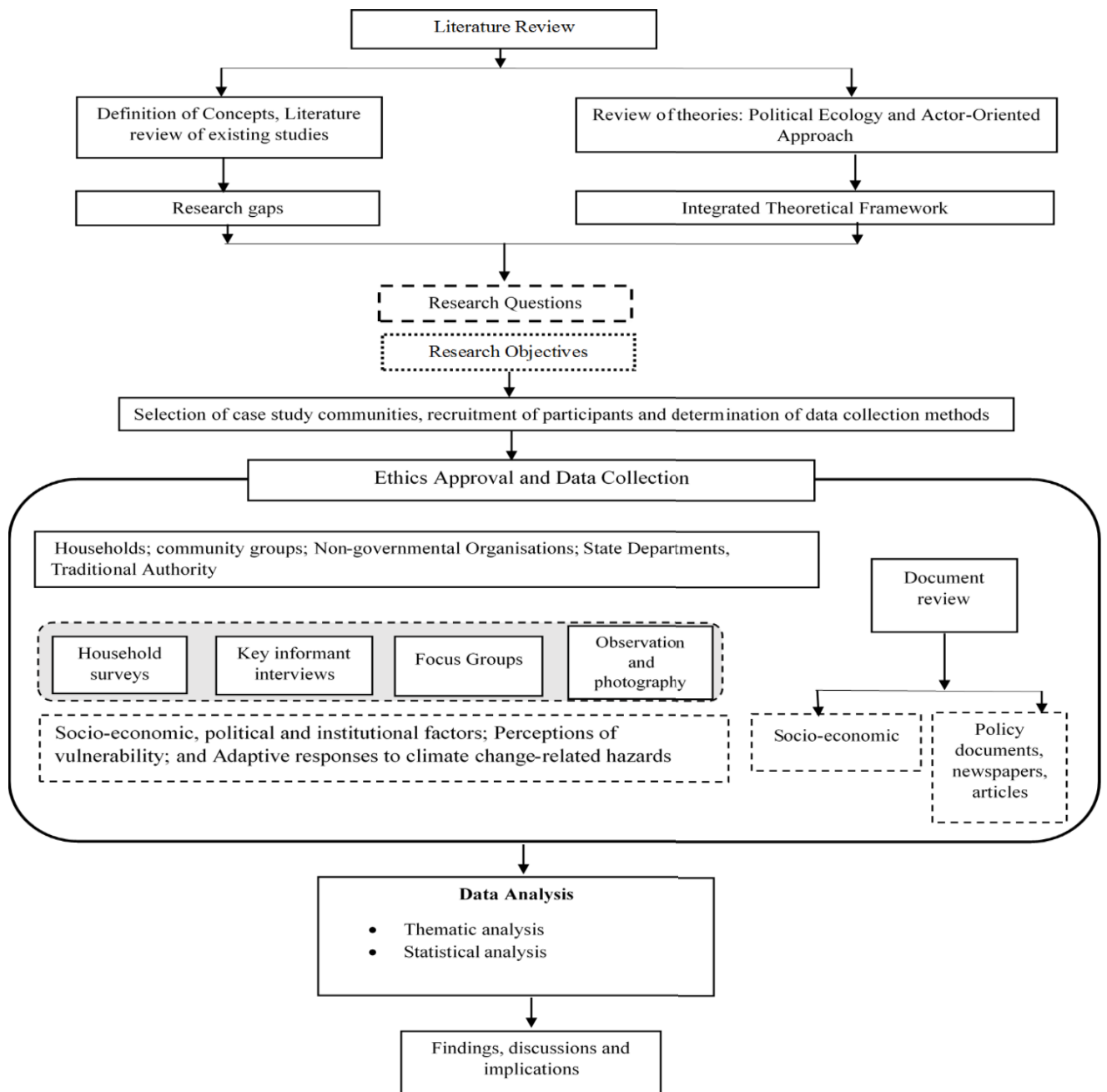
The study encountered a number of challenges and has some limitations. For instance, effective focus group discussions depend on the ability of participants to recollect and share knowledge as a group (Krueger & Casey 2014). However, focus group participants who were required to recall and rank past climate change-related events may not have easily done so. It was difficult

for participants to recall the exact days and times of major historical climatic events, such as major floods, storms, and evictions that had occurred in their communities. However, this limitation was addressed by using different sources of information, such as household surveys, focus group discussions as well as newspapers in triangulation.

A second limitation is the prior unavailability of up-to-date socio-economic and demographic data on all the study communities. Based on the often held perception that residents of informal settlements are illegal occupants of their land, residents of squatter settlements tend to be excluded from national censuses, as was the case of Ga-Nshonaa and Old Fadama in this study. This has meant that the population size of Ga-Nshonaa had to be estimated within the given constraints. Nevertheless, these limitations were addressed by acquiring data from non-governmental organisations that work with informal communities, as well as consulting other relevant documents, including field counts of dwellings. On the other hand, the collection of primary data through this study allowed the scholar to compare data in some circumstances with census data on Accra. Therefore, the combination of methods adopted, and triangulation of data sources has served to enhance the validity of the findings of this study. However, the choice of Accra, Ghana as a case study also means that results of this study are only generalizable to theory.

Finally, some respondents were initially reluctant to share some data due to their perceived 'illegal' status and feeling that giving out data will provide too much information to the city authority to tax them or carry out their evictions. This limitation related to reluctance of community members was addressed by assuring them about the confidentiality and anonymity of their information. Also, where such potential respondents were not satisfied, the survey team replaced them with other available households. Overall, however, the effects of these limitations have been minimised in this study through the adoption of different sources of data collection, in the form of methodological triangulation (as shown in Figure 4.2).

Figure 4.2: Research Flow Diagram



Source: Author's construct

4.13 Socio-demographic Characteristics of the Study Respondents

Participants in this study were of varied socio-economic characteristics, as shown in Table 4.7. They were mostly between the ages of 18 and 35 years (52.6 percent). However, about 3.1 percent of the respondents are older than the retirement age of 60 years in the Ghanaian context. This suggests that the respondents are mainly capable of offering labour for the livelihoods of

their household members. In terms of gender, most (87.5 percent) of respondents are male; only 12.5 are female as household heads. This gender disparity of leadership of household is also common in the Ghanaian society, as cultural practices tend to more project the heroic role of men, as noted by Agyei-Mensah & Wrigley-Asante(2014).

In terms of the ethnic origin of the respondents, which relates to their migration and rights to natural resources, the highest single group of respondents were native 'Ga' ethnic group (35.7). This is followed by Akan (28.2), the largest ethnic group in Ghana. However, overall, over 64 percent of the respondents are migrants, which has ramifications for their rights to land in Accra.

The respondents can also be described as people with mostly lower to no level of formal education; 80 percent of respondents have basic education or no education. This level of education of the respondents suggests why they participate in the informal economy, which is unregulated and without a need for higher education for entry. The education status may also have an influence on their knowledge about climate change. Also, the respondents mostly (63.9 percent) lived in the settlements for between less than 10 and 20 years; only 34.2 percent of the respondents have lived in the settlements for less than ten years. Differences in the length of stay of a household in a community are often associated with a household's ability to establish and main social ties and influences their social capital (Jabeen, Johnson and Allen 2010).

Table 4.8: Socio-demographic Characteristics of the Study Respondents

Variable	Sub-category	The proportion of respondents (%)
Age of household head	Between 18 and 25 years	6.9
	Between 26 and 35 years	46.7
	Between 36 and 45 years	22.9
	Between 46 and 55 years	12.5
	Between 56 and 60 years	7.9
	61+ years	3.1
Gender of the household head	Male	87.5
	Female	12.5
The ethnicity of the household head	Ga	35.7
	Akan	28.2
	Ewe	8.4
	Guan	0.2
	Gurma	1.7
	Mole- Dagbani	19.6
	Grusi	2.9
	Mande	0.3
	Other	2.9
Education of household head	Primary	27.5
	Junior High School	30.4
	Middle School Leaving Certificate	10.1
	Secondary	12
	Vocational/Technical	5.2
	Tertiary	3.8
	Professional	0.2
	None	10
Duration of residence of the household head	Less than ten years	34.2
	Between 11 and 20 years	29.7
	Between 21 and 30 years	18.6
	Over 30 years	17.5
Incomes per month/households	Less than AU\$100 (AU\$1=GHC3.3)	4.6
	Between AU\$100-AU\$200	23.7
	Between AU\$201 and AU\$300	22.2
	Between AU\$301 and AU\$400	12.37
	Between AU\$401 and AU\$500	16.2
	Between AU\$501 and AU\$1000	9.8
	Over AU\$1000	2.7
Mean income per month/households	AU\$361	
Maximum income per month/households	AU\$4326	
Minimum income per month/households	AU\$7	

Source: Author's construct based on households' survey

Furthermore, household incomes were found to have been unevenly distributed; the maximum monthly income reported is AU\$4327, while the minimum is less than AU\$7 (Table 4.8). However, with the mean household size of 2.87, respondents' mean income per month is only AU\$367, which translates into AU\$4.2 per person per day. It can, therefore, be argued that the

respondents are highly socially and economically differentiated, and not a homogenous group of poor people.

4.14 Profiles of the Selected Study Settlements

4.14.1 Adedenkpo

Adedenkpo is an inland-informal settlement, located in the indigenous landowning area of Ga-Mashie, covering a land area of about 49 acres (19.8 hectares). As a traditional ‘Ga’ settlement, its existence predates the political independence of Ghana. Available data from Accra Metropolitan Assembly (2014), placed their population at 32,340 and about 9800 households.

Figure 4.3 shows that the settlement covers parts of James Town, also called ‘British Accra’ in the south, sharing boundaries with Amaamoo, in the East and with the ‘Timber Market’ and Agbogbloshie in the north-east. In the north-west is the Korle Lagoon, while the western boundary includes a light industrial enclave and the Korle Lagoon. According to local leaders, land in the north-western part of the settlement near the Korle Lagoon is owned by the Ghana Railways Corporation.

Figure 4.3: Location and Boundaries of Adedenkpo



Source: Author’s construct based on Google Earth maps

Adedenkpo differs from many informal settlements in terms of spatial structure, as shown in Figure 4.3. The settlement includes a visible road network, depicting a somewhat rectilinear pattern. This pattern has been explained by a community leader as accounted for by earlier attempts at formal planning in the settlement during the colonial era in Ghana, which involved creation of access through road construction in sections of the settlement.

4.14.2 Ga-Nshonaa

The informal settlement 'Ga-Nshonaa', unlike Adedenkpo, is a squatter shoreline settlement located in the ethnic 'Ga' enclave. Unlike Adedenkpo, Ga-Nshonaa settlement as dwelling emerged from the complex urbanisation processes in Accra in the early 2000s, according to residents. Field estimates in the community, before data collection, placed its population at about 5,001 residents and daily workers, comprising about 1,667 households. According to local settlement leaders, although the settlement has suffered from forced evictions, its population has been increasing, partly due to increasing forced evictions in other parts of the city.

Figure 4.4 shows the settlement occupies an area of about 38 acres (15.4 hectares). The southern boundary is the Gulf of Guinea, while it is separated from both James Town and Ussher Town, by a road in the north.

Figure 4.4: Location and Boundaries of Ga-Nshonaa



Source: Author's construct based on Google Earth maps

Even though the state acquired the land in this settlement since the colonial era (Grant & Yankson 2003a), land ownership in Ga-Nshonaa is presently highly contested. This was articulated by a settlement leader in response to a question on who owns the land when he said:

Before the harbour was constructed, the 'colonial masters' acquired the land from the Jamestown people, and after they left the land went to the Ghana Ports and Harbours Authority. Now, many people claim ownership of the land. The Sempe people, the Ngleshi people and a whole lot claim the land is theirs. So now everyone is fighting over the land, and we do not even know the rightful owner any more (Participant #7, General Focus Group, Ga-Nshonaa).

The settlement dates back to when it only served as a landing beach for native 'Ga' fishermen, following the relocation of the port to Tema, a city located in the east of Accra in 1962 (Grant 2009). According to local leaders in interviews, migrant fishermen who ply their trade following fishing seasonality patterns, begun living in the settlement after work. This situation changed when more fishermen, including local 'Ga' decided to stay over the night to protect their fishing gears, due to security concerns. However, the full-fledged residential function of the settlement commenced in only about 2000. The spatial structure of Ga-Nshonaa differs

from the other case study settlements as it is more irregular, with dwellings mostly constructed of make-shift and inflammable materials.

4.14.3 Gbegbeyise

Gbegbeyise is also an informal shoreline settlement, located along the western coast of Accra. The settlement occupies a land area of about 128 acres (51.2 hectares). Available data collected from Accra Metropolitan Assembly (AMA 2014) indicate that an estimated 13,349 people, comprising of about 4944 households lived in the community. According to the traditional ruler of the settlement, it was founded by Nii Ayitey Gyata We (clan) from Bukom in Gamashie, and Nii Anan from Fanteland in 1827. The traditional leader recounts the history of the chieftaincy in their community, noting that: “*When the community was started, there were no chiefs until 1980 when the community started a chieftaincy system*” (Interview #4). Although the current population is heterogeneous (AMA 2014), the traditional leaders regard Gbegbeyise as a ‘Ga’ native settlement, as its traditional governance owes allegiance to the Sempe Stool (traditional authority) in Old Accra.

Figure 4.5: Location and Boundaries of Gbegbeyise



Source: Author's construct based on Google Earth maps

The settlement is partially located on a sandbar in the boundaries with its neighbouring Glefe, while the Gbugbe Lagoon, runs through sections of the settlement as shown in Figure 4.5. This community shares a boundary with Mpoase in the north and Glefe in the west. By this location,

the community is also near the ‘salt ponds’ of Panbros Salt Manufacturing Ghana Limited, which is sited in the neighbouring Glefe community. It has been suggested by community leaders that, the periodic spillage of water from the ponds of Panbros Salt Manufacturing Ghana Limited, often affect flooding in their community. Overall, Gbegbeyise’s spatial structure is one of a merged landmass of buildings, with very few crooked alleys, that have been reportedly reducing over time.

4.14.4 Old Fadama

Old Fadama, a highly contested settlement located on a 123 acres (49.8 hectares) land along the Odaw River and the Korle Lagoon, is the largest and most known informal settlement in Accra (Figure 4.6). The size of the population of the settlement has been estimated at 81,325 people making up about 36,966 households (PD & HM 2009).

The current rise of this settlement has taken many processes. Following the relocation of some earlier settlers to New Fadama, many present residents of this community were relocated from the Osu area in Accra following a decongestion of the city in the 1990s. According to Afenah (2009), this resettlement by the state was temporary. However, Amoako (2015) has recounted two other major events that account for the present population of the settlement. One event was the movement of people from the northern part of Ghana fleeing an inter-tribal conflict [the Kokomba-Nanumba conflict] in the 1990s. Another event that took place was in 1993, led by the Accra city authorities who relocated a yam market to the Old Fadama precincts. This has resulted in the main food market for Accra, providing sources of employment for the settlements’ mainly unskilled migrant residents (Afenah (2009).

Figure 4.6: Location and Boundaries of Old Fadama



Source: Author's construct based on Google Earth maps

There are also contests by the traditional landowners from the Korle and Gbese Stools (traditional authorities), whose land was acquired by the state for an ecological restoration project in the city (Grant, 2009). Overall, the spatial structure of Old Fadama is an organically merged land mass, with few long and narrow access ways. This has made it difficult for motorists to access the community, especially during emergencies (Grant 2009).

4.15 Conclusion

This chapter has outlined the methodology adopted to investigate the factors underlying the vulnerability and responses of residents of informal settlements to climate change. The chapter involves a justification for adopting a constructivist ontology using a mix of qualitative and quantitative data collection and analysis techniques to answer the research questions. In addition, the chapter has shed light on the justification for analysing the vulnerability and adaptive practices of the study respondents as a case. It has also been shown that the research design, which is primarily a case study, also embeds cross-sectional design since household survey data were required. Moreover, the justification for the four selected case study settlements, as well as data collection and analytical techniques have been discussed in this chapter. Furthermore, the limitations of this study have been outlined in this chapter, while also

showing how such limitations have been addressed. Lastly, the socio-ecological contexts of the four case study settlements have been presented in this chapter. The nature of the vulnerability of the residents of the four study communities is presented in the next chapter.

5 CHAPTER FIVE: DIFFERENTIAL PERCEIVED VULNERABILITY AND CLIMATE CHANGE-RELATED HAZARDS

5.1 Introduction

This chapter presents the findings and discussions of the study respondents' vulnerability to climate change-related hazards, as influenced by their socio-economic, political and institutional contexts. It provides an answer to the first main thesis question of "Which factors drive the vulnerability of residents of informal settlements to climate change-related hazards as a contextual experience in Accra?" Two sub-questions, which are also answered in this chapter are: 1) which social, economic, political and institutional factors are associated with the perceived vulnerability of residents of informal settlements to climate change-related hazards? and 2) what are the most frequently experienced climate change-related hazards among residents of informal settlements in Accra? Results discussed in this chapter are based on a household survey that was conducted in the four study settlements. The survey results are further elaborated on throughout the chapter with results from the focus groups meetings, as well as interviews which were conducted with staff of relevant state institutions.

The rest of this chapter is structured into four sections. The first section covers the findings on socio-economic drivers of the study respondents' vulnerability. Following this, political and institutional-related drivers of the study respondents' vulnerability are discussed. Since biophysical vulnerabilities partly constitute the respondents' experience, the last section then presents their 'perceived vulnerability' as an intrinsic measure of their contextual vulnerability to hazards. Together, the sections of this chapter show that, while socio-economic, political and institutional factors differentially account for the respondents' vulnerability, their access to land is the main associated factor.

5.2 Socio-economic Drivers of Vulnerability

It has been argued that urban dwellers' vulnerability to climate change-related hazards is often influenced by their socio-economic status; it determines the nature of assets (such as financial resources and dwellings) they can accumulate to protect themselves from hazards (Blaikie et al. 2014; O'Brien et al. 2006). In this section, the socio-economic and related policy factors that

underlie the respondents' exposure to hazards are presented, beginning with their reasons for settling in community and labour supply-related constraints.

5.2.1 Reasons for Settling in Community and Labour Supply-related Constraints

The importance of employment and incomes in reducing households' exposure to climate change in informal settlements cannot be overemphasised (Brown, McGranahan & Dodman 2014). By supplying labour in employment, urban households earn incomes and accumulate assets (such as financial resources and dwellings) to meet their general wellbeing objectives, including reducing risks to climate-related hazards (Bulkeley 2013). Moreover, in spite of the high risk to hazards, residents of informal settlements tend to continuously occupy them due to various push factors and reasons (Isunju, Orach and Kemp 2015). This study sought to examine how the respondents participate in the labour market beginning with why they settled in their present localities.

Survey results in Table 5.1 show that households either chose to move to or originated from their communities in this study. Specifically, they chose to move for economic reasons, maintain family ties or for government intervention or 'other'. Results show that while most respondents in Ga-Nshonaa (65.9 percent), Old Fadama (94 percent) and almost half those in Gbegbeyise (48.6 percent) settled in their communities for economic reasons, most respondents in Adedenpko (55.5 percent) originated from their community. In terms of gender, a relatively higher percentage of females (77.8 percent) than male (65.1 percent) respondents in Ga-Nshonaa claimed to have settled for economic reasons. This was found to be marginally different among respondents in Gbegbeyise; 48.8 percent of males as compared to 47.6 percent of females reported so. By contrast, all female respondents (100 percent), compared to 93 percent of male respondents in Old Fadama settled for economic reasons. Overall, the results suggest a potential disproportionate burden of state policy on females than male respondents and their exposure to hazards.

These findings may be understood in the context of the implementation of historical economic policies in Ghana, which influenced many rural dwellers to migrate to Accra, as earlier discussed in Chapter Two of this thesis (section 2.2). The finding that most respondents in three of the four case study communities settled for economic/financial reasons has also been reported by other studies as related to proximity to economic opportunities in Accra (Arku, Luginaah & Mkandawire 2012; Owusu & Oteng-Ababio 2015). Twum and Abubakari (2019)

also found this to be related to lower rents levels; while the average rent in informal settlements in Accra was GH¢ 35.00 per month, the average minimum in formal areas was nearly three times higher (GH¢ 120.00). This was also reported as the main reason for settling in their community among residents of Korail in Dhaka (Bangladesh) in a study conducted by Jabeen, Johnson and Allen (2010). Similarly, Isunju, Orach & Kemp (2016) reported this as the second main reason for the study respondents in Kampala (Uganda). Together, the findings support Cutters (1996)'s argument that emphasises the importance of historical policy contexts in hazard 'vulnerability of place' analysis.

Table 5.1: Reason for Settling in Community According to Percentage of Gender of Respondents

Settlement/community and the main reason			Gender		Total
			Male	Female	
Adedenpko	Economic reasons/ financial considerations	%	37.6	47.8	39.2
	Maintain family ties	%	2.4	0.0	2.0
	Originate from community / settlement	%	56.0	52.2	55.4
	Government intervention	%	0.8	0.0	0.7
	Other	%	3.2	0.0	2.7
	Total	N	125	23	148
		%	100.0	100.0	100.0
Ga-Nshonaa	Economic reasons/ financial considerations	%	65.1	77.8	65.9
	Maintain family ties	%	1.6	0.0	1.4
	Originate from community / settlement	%	7.8	0.0	7.2
	Other	%	25.6	22.2	25.4
	Total	N	129	9	138
		%	100.0	100.0	100.0
Gbegbeyise	Economic reasons/ financial considerations	%	48.8	47.6	48.6
	Maintain family ties	%	3.2	0.0	2.7
	Originate from community / settlement	%	28.8	23.8	28.1
	Other	%	19.2	28.6	20.5
	Total	N	125	21	146
		%	100.0	100.0	100.0
Old Fadama	Economic reasons/ financial considerations	%	93.1	100.0	94.0
	Government intervention	%	3.1	0.0	2.7
	Other	%	3.8	0.0	3.3
	Total	N	130	20	150
		%	100.0	100.0	100.0

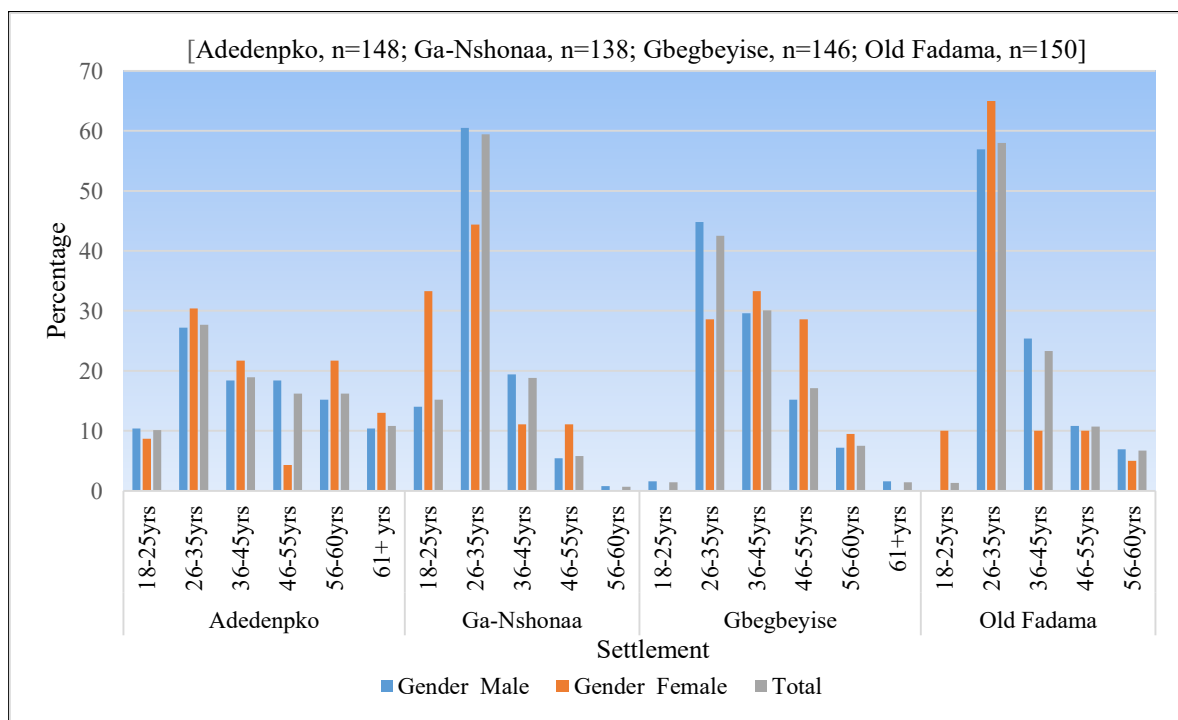
Source: Author's construct, based on the household survey

Also essential in the socio-economic conditions and vulnerability of urban dwellers is the nature of employment opportunities that one can access. In Accra, the Ghanaian State categorises the age range of 18 to 60 years as economically active population, which is also the age group that gains employment in the public service (GSS 2014). Analysis of responses in

Figure 5.1 indicates most respondents in Adedenkpo (89.2 percent), Ga-Nshonaa (100 percent), Gbegbeyise (98.6 percent) and Old Fadama (100 percent) were aged between 18-60 years old.

Gender differences were also noticeable among this economically-active age group in the various study communities. Only marginal differences were noticeable among the proportions of male (27.2 percent) and female (30.4 percent) respondents in the most dominant age-cohort (26-35 years) in Adedenkpo. In contrast, marked differences were noticeable among respondents of the different gender groups of the same age-cohort (26-35 years) in Ga-Nshonaa (60.5 percent male and 44.5 percent female), Gbegbeyise (44.8 percent male and 28.6 percent female) and Old Fadama (56.9 percent male and 65.0 percent female) (Figure 5.1). Overall, the finding that over a tenth (10.8 percent) of the respondents in Adedenkpo and 1.4 percent in Gbegbeyise were aged above 60 years, while no respondents in Ga-Nshonaa and Old Fadama were above 60 years, supports existing knowledge that suggests a relationship between tenure security and age of residents of informal settlements. It has been shown that informal settlements without recognised security of tenure are often inhabited by a youthful and transient population (Shatkin 2004). In this study, Adedenkpo and Gbegbeyise are legally recognised by the local authorities, which contrasts with Ga-Nshonaa and Old Fadama as squatter settlements.

Figure 5.1: Proportion of Male and Female Respondents by Age Category

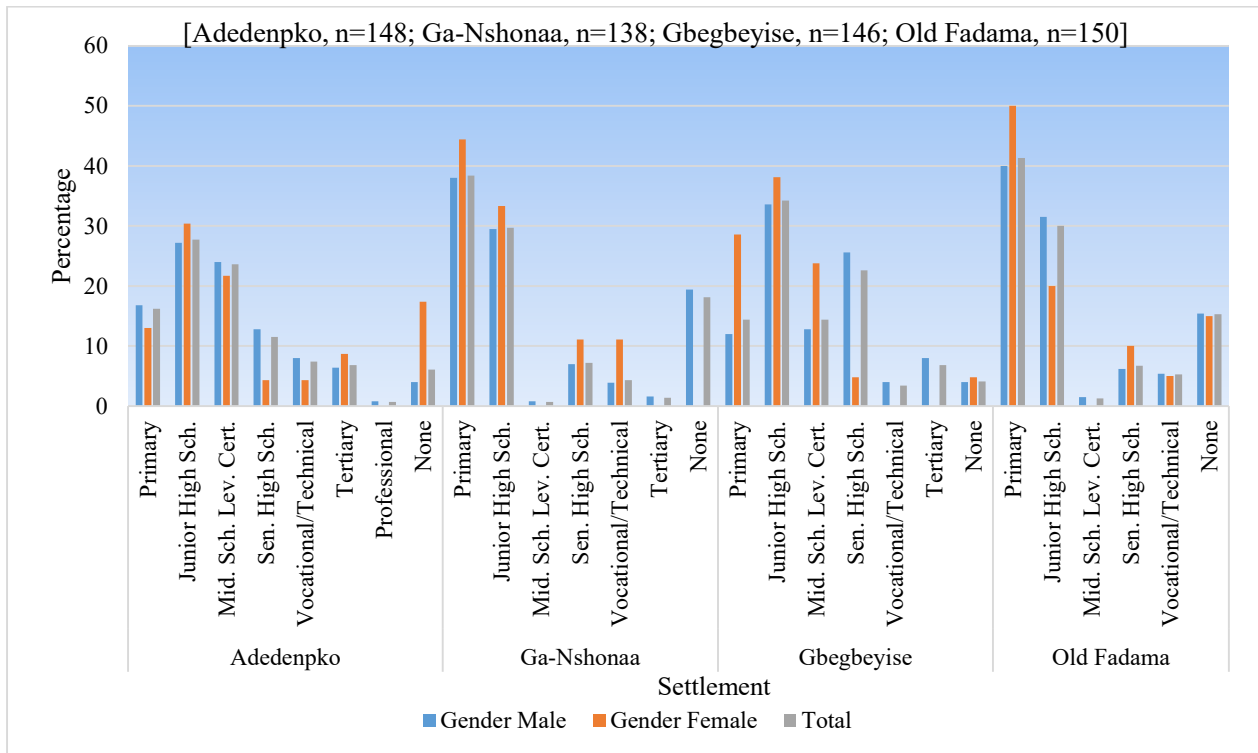


Source: Author's construct, based on the household survey

In addition to factors that serve to ‘push’ a household to settle in a particular locality, Wachtel (1971) suggests the educational level of a head of household as crucial in their ability to participate in the labour market. In spite of this recognition, the findings in Figure 5.2 shows at least over a quarter (at least 76 percent) of the respondents with basic education qualification in all the study settlements: Adedenpko (79 percent), Ga-Nshonaa (76.2 percent), Gbegbeyise (85.7 percent) and Old Fadama (79.4 percent). This contrasts with relatively fewer respondents claiming to have vocational/tertiary/professional education qualifications, in the same communities, as shown in Figure 5.2. Noteworthy is the relatively higher proportion of respondents without formal education certification in Ga-Nshonaa (18.1 percent) and Old Fadama (15.3 percent) than those with higher levels of education in the same communities.

Educational levels of the respondents in the various communities were also distinguished according to their gender. It is shown in Figure 5.2 that while marginal differences were notable among male and female respondents without formal education in Gbegbeyise (4.0 percent male and 4.8 percent female) and Old Fadama (15.4 percent male and 15.9 percent female), the differences were more marked among respondents in Adedenpko (4.0 percent male and 17.4 percent female) and Ga-Nshonaa (19.4 percent male and none for female). Compared to the rest of Ghana, 19.7 percent, 44.6 percent, 20.9 percent and 14.7 percent of all persons in Ghana above 15 years were found to have no formal education, primary, vocational/junior/senior high and tertiary education qualifications, respectively (GSS 2014). Resulting from lower levels of education, over 83 percent of respondents in each study community reported as working in the informal economy (further discussed in Chapter Seven).

Figure 5.2: Proportion of Male and Female Respondents by Levels of Education



Source: Author’s construct, based on the household survey

Nevertheless, even inclusive of the aged, the level of unemployment rate in Accra at about 7 percent (GSS 2014) is relatively higher than those reported in Adedenpko (5.4 percent), Ga-Nshonaa (3.6 percent), Gbgbeyise (4.8 percent) and Old Fadama (4.0 percent). This finding supports the existing view that the question of employment in informal settlements has often been less about the absence of employment, as it is relatively easier to enter the informal labour market. Their predominant reliance on precarious and vulnerable jobs exposes them to various forms of economic vulnerabilities. (Brown & McGranahan 2016).

5.2.2 Economic Activity-Related Constraints and Influence on Incomes

The importance of the nature of economic challenges and incomes of a household’s vulnerability to climate change-related hazards cannot be overlooked (Bulkeley 2013). Economic challenges influence a households’ income, which in turn influences a household’s ability to accumulate assets for responding to general wellbeing objectives including climate-related hazards (Blaikie et al. 2014; Bulkeley 2013).

Analysis of the livelihood-related constraints faced by the respondents shows differentiated potential economic vulnerabilities according to their location and gender (Table 5.4). Table 5.4 shows that while the highest percentage of respondents in Adedenpko (41.9 percent), Ga-

Nshonaa (36.2 percent), and Gbegbeyise (58.2 percent) viewed access to credit as the single most significant livelihood challenge, for the respondents in Old Fadama (38.7 percent), this was ‘harassment’ over their land by city authorities. Such harassments were also reported among over a fifth of respondents in Adedenpko (20.3 percent) and Ga-Nshonaa (33.3 percent). Forms of harassment as reported during focus group meetings related to intimidation and attacks by city guards in their places of work. This is exemplified by a community member who opined that:

.....when we sell our wares on the pavements, the city guards frequently attack us with canes. These attacks sometimes make it difficult for us to concentrate on our work and sometimes, we even abandon our wares (Participant #3, Trades, and commerce, FGD, Old Fadama).

Similar concerns were also reported by residents of other informal settlements in a study conducted by Adaawen and Jørgensen (2012) in Accra.

Also, it was found that some respondents held the perception that the ‘absence or lack of legal/official recognition’ for the work they do, denied them access to state support, such as training. Up to 16.2 percent of the respondents in Adedenpko, 18.5 percent in Gbegbeyise and 24.0 percent in Old Fadama reported this perception. This was further elaborated on during focus group meetings as in Adedenpko when a participant noted that:

.....for instance, I nearly got a service contract to supply uniform to a school, but they realised I did not have registration documents, so they gave it to another person. Also, we do not get any training benefits from the government to help us in our work since the government does not recognise what we do in their records (Participant #2, Trading and Commerce, FGD, Adedenpko).

This absence of legal recognition can be understood in the context of the cumbersome business registration regime in Ghana. The Ghanaian Company Registration Code, 1963 (Act 179) and the Business Name Act, 1962 (ACT 151) together specify the requirements for registering and operating a formal business.

Table 5.2: Perceived Most Significant Livelihood-related Challenge According to Gender of Respondents

Settlement/community and livelihood challenge			Gender		Total
			Male	Female	
Adedenpko	Prohibitive laws/regulations	%	2.4	4.3	2.7
	Access to credit	%	44.8	26.1	41.9
	Access to land/space	%	9.6	13.0	10.1
	Exploitation by employers or others	%	2.4	17.4	4.7
	Physical harassment in place of work	%	20.8	17.4	20.3
	Lack of state legal recognition and support	%	15.2	21.7	16.2
	Low demand for their wares/services	%	4.8	0.0	4.1
	Total	N	125	23	148
	%	100.0	100.0	100.0	
Ga-Nshonaa	Prohibitive laws/regulations	%	14.0	33.3	15.2
	Access to credit	%	37.2	22.2	36.2
	Access to land/space	%	6.2	11.1	6.5
	Physical harassment in place of work	%	33.3	33.3	33.3
	Lack of state legal recognition and support	%	4.7	0.0	4.3
	Low demand for their wares/services	%	4.7	0.0	4.3
	Total	N	129	9	138
	%	100.0	100.0	100.0	
Gbegbeyise	Prohibitive laws/regulations	%	2.4	0.0	2.1
	Access to credit	%	58.4	57.1	58.2
	Access to land/space	%	0.8	0.0	0.7
	Exploitation by employers or others	%	3.2	0.0	2.7
	Physical harassment in place of work	%	2.4	0.0	2.1
	Lack of state legal recognition and support	%	19.2	14.3	18.5
	Low demand for their wares/services	%	13.6	28.6	15.8
	Total	N	125	21	146
	%	100.0	100.0	100.0	
Old Fadama	Prohibitive laws/regulations	%	1.5	0.0	1.3
	Access to credit	%	6.2	0.0	5.3
	Access to land/space	%	14.6	15.0	14.7
	Physical harassment in place of work	%	40.8	25.0	38.7
	Lack of state legal recognition and support	%	24.6	20.0	24.0
	Low demand for their wares/services	%	12.3	40.0	16.0
	Total	N	130	20	150
	%	100.0	100.0	100.0	

Source: Author's construct, based on the household survey

In addition to a challenge of the absence of legal recognition, perceived livelihood challenges reported by the respondents included ‘difficulty in accessing space to work’, work-related ‘exploitative practices’, and ‘low demand for their wares’ (Table 5.4). Of these, low demand for their services/wares was considered a significant livelihood challenge by at least 15 percent of the respondents in both Gbegbeyise (15.8 percent) and Old Fadama (16.0 percent). However,

the same was considered only marginally significant by respondents in both Adedenpko (4.1 percent) and Ga-Nshonaa (4.1 percent). These economic-related challenges were elaborated on during focus group meetings in the study communities. An example is the reported combined challenge of ‘low demand for wares’ and the effect of inflation on the cost of production input. This was referred to by focus group participants as shown by a community member in Ga-Nshonaa who voiced out that:

My work has not seen any progress because, people do not buy our fish as before, while prices of our inputs too keep on increasing. In 2014, I bought an outboard motor at GH¢2,950, and the last one I bought last year cost me GH¢7,600 (Participant #4, Focus Group for Fishing, Ga-Nshonaa).

Overall, the findings on ‘difficulty in registration’, ‘access to credit’, and ‘low demand for wares’, were also highly ranked among respondents in a study conducted by Anyidoho (2013) in Accra. The impact of this challenge was also associated with the macro-economy of Ghana and was also reported as the foremost challenge among informal traders by Anyidoho and Steel (2016). In this study, Anyidoho and Steel (2016) reported that the most significant challenge to workers in informal commerce was the depreciation of the Ghanaian currency (the cedi). Nevertheless, as noted by Anyidoho and Steel (2016), the challenge of access to credit as reported in this study seems more related to a high cost of borrowing than the unavailability of credit. This finding is against the reported finding that economic reforms embarked upon in Ghana have led to the prevalence of financial institutions since 2000 in Accra (Anyidoho and Steel 2016).

The survey results also revealed the highly differentiated household incomes of the respondents according to their community and tenancy statuses (Table 5.5). Annual household income distribution was spatially distinguished, with the highest percentage of the respondents in Adedenpko (35.8 percent) and Gbegbeyise (37.7 percent) reporting to earn in the fourth quartile (over GH¢ 18,500.00). By contrast, the highest in Ga-Nshonaa (39.1 percent) reportedly earned in the third quartile (GH¢11,660.00 - GH¢18,500.00). This was comparatively better than the case of respondents in Old Fadama, where the highest percentage (30.7 percent) was also found in the third quartile. No known reason explains this finding as there are comparatively better economic prospects in Old Fadama given its proximity to the largest open market in Accra. Overall, however, when this income is compared to the mean

annual income of GH¢74,893 for urban dwellers in Ghana (GSS 2014), the study respondents are relatively economically poorer.

Furthermore, income distribution among the respondents also differed according to their tenancy statuses (Table 5.5). As displayed in Table 5.5, higher proportions of landlords than tenants in Gbegbeyise (41.5 percent and 34.5 percent, respectively) and Old Fadama (34.2 percent and 19.4 percent, respectively) were found in the third quartile. This was different for respondents in Adedenkpo where more tenants (37.5 percent) than landlords (34.5 percent) earned in the fourth income quartile (over GH¢18500.00). Conversely, more tenants than landlords in Gbegbeyise and Old Fadama earned in the first quartile (less than GH¢7000) contrary to the case of Adedenkpo where more landlords than tenants do so (Table 5.3). It can thus be inferred that property ownership of some respondents may play a role in the nature of incomes they earn and their ability to respond to hazards. This therefore differentially exposes them to climate change-related hazards, as was found in similar studies such as Roy, Hulme & Jahan (2013). Overall, the findings support the often held view that residents of informal settlements are not a homogenous group of poor people, as they tend to be socio-economically differentiated and exposed to hazards (Brown and McGranahan 2016).

Table 5.3: Annual Household Income Distribution According to Tenancy Status of Respondents

Settlement/community and income in GH¢			Residential tenancy status		Total
			Landlord	Renter/tenants	
Adedenpko	Q1: <7,000	%	23.9	19.6	22.3
	Q2: 7,000.01 – 11,660	%	15.2	26.8	19.6
	Q3: 11,660.01 – 18,500	%	26.1	16.1	22.3
	Q4: 18,500.01 +	%	34.8	37.5	35.8
	Total	N	92	56	148
%		100	100	100	
Ga-Nshonaa	Q1: <7,000	%	14.5	0	14.5
	Q2: 7,000.01 – 11,660	%	32.6	0	32.6
	Q3: 11,660.01 – 18,500	%	39.1	0	39.1
	Q4: 18,500.01 +	%	13.8	0	13.8
	Total	N	138	0	138
%		100	0	100	
Gbegbeyise	Q1: <7,000	%	27.7	39.5	34.2
	Q2: 7,000.01 – 11,660	%	18.5	17.3	17.8
	Q3: 11,660.01 – 18,500	%	12.3	8.6	10.3
	Q4: 18,500.01 +	%	41.5	34.6	37.7
	Total	N	65	81	146
%		100	100	100	
Old Fadama	Q1: <7,000	%	22.8	44.4	28
	Q2: 7,000.01 – 11,660	%	34.2	19.4	30.7
	Q3: 11,660.01 – 18,500	%	30.7	25	29.3
	Q4: 18,500.01 +	%	12.3	11.1	12

Source: Author's construct, based on the household survey

The reported influence of the economic policy context of Ghana on the study respondents' vulnerability to climate change, is also similar to findings of other studies conducted in Ghana (Dankelman 2002; Dankelman 2008). Dankelman's (2008) study reported that the privatisation agenda pursued by the Government of Ghana during the economic reforms had influenced the migration of rural population to urban areas. Among the urban migrants is the urban poor residing in informal settlements often with limited to no access to basic amenities such as drainage infrastructure for responding to climate change-related hazards (Dankelman 2002).

5.3 Institutional (regulatory) and Political Drivers of Vulnerability

This section is a presentation of the findings and discussions related to how institutional (the regulatory arrangements) and political-related factors potentially influenced the study respondents' vulnerabilities. As political and institutional factors in informal settlements include governance and institutional arrangements in cities (Hardoy & Satterthwaite 2014a), this study sought the respondents' views on the extent to which they have access to political

and decision-making processes, therefore to control over resources. Common access resources, such as land, are crucial for urban residents to cope with social and environmental hazards. Moreover, access to, and control over resources is a component of the theoretical framework of this thesis (Roy, Hulme & Jahan 2013).

5.3.1 Institutional Arrangements and Land Tenure

The importance of access to land in shaping the vulnerability of a household in urban areas to climate change-related hazards, cannot be under-stated. Access to land has an influence on households' decision-making authority in carrying out modifications on their dwellings to reduce their exposure to hazards (Wamsler & Brink 2014). Despite this recognition, most of the respondents in Ga-Nshonaa (99.3 percent), Gbegbeyise (74.7 percent) and Old Fadama (96.7 percent) claimed their accesses to land was through informal arrangements. In contrast, most respondents in Adedenpko (53.4 percent) claimed to have customary rights to their land (Table 5.6). Customary land rights are embedded in social customs, norms, traditions and value systems. Therefore land under customary rights belongs to kinship groups consisting of ancestors, the living as well as future generations; and its usage is often contested (Aryeetey-Attoh 1997).

On the other hand, informal land usage arrangements which exist in many informal settlements globally, are often undocumented agreements between a user and another person who assigns the land, often without formal documentation (Porter et al. 2011). In addition to customary and informal land usage rights, it was found that less than 13 percent of respondents in Adedenpko (12.8 percent), Gbegbeyise (6.8 percent) and Old Fadama (3.3 percent), claimed to have leasehold rights to their land. The finding that some respondents in Old Fadama claimed to exercise leasehold right does support Grant's (2009) assertion that land use rights in Old Fadama are characterised by confusion and conflicts.

In terms of gender, only marginal differences were noticeable among the respondents relative to the nature of land use rights in the various study communities, as shown in Table 5.4. This finding is contrary to the dominant discourse that suggests that women tend to have less land access rights than men in Africa, often due to cultural biases against the former (Nabulo et al. 2004). For example, a study conducted by Guloba (2014) in Uganda shows that women had less access to land than men due to unfavourable customary practices and land management

related conflicts in the country. Nevertheless, the finding in this current study may be explained by the important role that women play in the native ‘Ga’ culture. In the ‘Ga’ culture, women as sometimes the clan heads, do exercise equal land inheritance rights as men (Parker 2000b).

Moreover, the nature of land use rights as found in this study, when juxtaposed with the reported limited access to credit by the respondents, does support De-Soto (2000)'s assertion about the link between the poor’s access to credit and their institutional contexts (their land rights). For De-Soto (2000), non-recognition of informal property rights as collateral by financial institutions mainly accounts for informal residents’ inability to ride out of poverty.

Table 5.4: Tenure Security Type According to Gender of the Respondents

Settlement/community and tenure security			Gender		Total
			Male	Female	
Adedenpko	Customary	%	52.8	56.5	53.4
	Leasehold	%	12.8	13	12.8
	Informal	%	34.4	30.4	33.8
	Total	N	125	23	148
		%	100	100	100
Ga-Nshonaa	State	%	0.8	0	0.7
	Informal	%	99.2	100	99.3
	Total	N	129	9	138
		%	100	100	100
Gbegbeyise	Customary	%	17.6	19	17.8
	Leasehold	%	7.2	4.8	6.8
	State	%	0.8	0	0.7
	Informal	%	74.4	76.2	74.7
	Total	N	125	21	146
		%	100	100	100
Old Fadama	Leasehold	%	3.1	5	3.3
	Informal	%	96.9	95	96.7
	Total	N	130	20	150
		%	100	100	100

Source: Author's construct, based on the household survey

Apart from the differences in land use rights among the respondents, hazards scholars assert that the land usage rights in cities influence urban dwellers’ vulnerability through the phenomenon of legal pluralism (Meinzen-Dick & Pradhan 2002). Legal pluralism, which describes a phenomenon in which multiple and competing sets of rules and norms regulate socio-economic and political relationships, can reduce a household’s response capacity to ecological and livelihood-related hazards (Meinzen-Dick & Pradhan 2002). In Accra, relevant laws for land use planning and developmental control are the Local Governance Act, 2016 (Act 936), the National Development Planning Systems Act, 1994 (Act 468) and the Land Use and

Spatial Planning Act, 2016 (Act 925). Added to these regulations are the National Building Regulations (L.I.1630, 1992) and the National Building Code (2012). These state regulations have co-existed with cultural norms and informal regulations on land use in informal settlements in Accra.

The formal regulatory/institutional requirements for development permitting include the presence of a land title, conformity of any proposed development application with specific land sizes. In addition, the requirements for the development application include detailed building drawings, as well as conformity to a prescribed building material to be used. By these regulations [Section 46 of the Local Government Act, 1993 (Act 462)], the Accra Metropolitan Assembly, has the mandate to control physical development processes including provision of hazard-reduction infrastructure in the city. The study sought to examine the nature of exposure and potential vulnerabilities associated with land usage rights, including the knowledge of, and enforcement of land use regulations in the four study communities.

Survey results, as shown in Table 5.5, indicate that respondents' perceived 'threats of eviction' over land was spatially different. Over four in five respondents in both Ga-Nshonaa (96.4 percent) and Old Fadama (86.3 percent) claimed to have been subjected to 'threats of eviction' over their land. When compared to the respondents in Adedenpko and Gbegbeyise, the proportions were significantly lower at 35.1 percent and 15.1 percent, respectively. Moreover, this perception differed among landlord-households and renter-households. This was held more among renters than landlords in Adedenpko and Old Fadama while only marginally different among renters and landlords in Gbegbeyise (Table 5.5).

Together, the findings support findings from other studies which reported that vulnerability from 'threats of eviction' among residents of informal settlements is often associated with the nature of land ownership in the community (Desai & Loftus 2013; Haque, Dodman & Hossain 2014; Isunju, Orach & Kemp 2015). This has also been found to have influenced residents' decision-making on the upgrade of their dwellings to reduce their exposure to climate change-related hazards.

Table 5.5: Percentage of Tenants and Landlords/ladies who Perceive Threats of Eviction over their Land

Settlement/community and challenge of ownership over land			Residential tenancy status		Total
			Landlord	Renter/tenants	
Adedenkpo	Yes	N	21	31	52
		%	22.8	55.4	35.1
	No	N	71	25	96
		%	77.2	44.6	64.9
	Total	N	92	56	148
		%	100.0	100.0	100.0
Ga-Nshonaa	Yes	N	133	0.00	133
		%	96.4	0.00	96.4
	No	N	5	0.00	5
		%	3.6	0.00	3.6
	Total	N	138	0.00	138
		%	100.0	0.00	100.0
Gbegbeyise	Yes	N	10	12	22
		%	15.4	14.8	15.1
	No	N	55	69	124
		%	84.6	85.2	84.9
	Total	N	65	81	146
		%	100.0	100.0	100.0
Old Fadama	Yes	N	97	33	130
		%	85.1	91.7	86.7
	No	N	17	3	20
		%	14.9	8.3	13.3
	Total	N	114	36	150
		%	100.0	100.0	100.0

Source: Author's construct, based on the household survey

The reported ‘threats of eviction’ and related exposure to climate-related hazards, can be further understood in the context of the respondents’ knowledge about the formal regulations. It was found that at least 71 percent of respondents in each study settlement reported unawareness of developmental regulations, as shown in Table 5.6. However, while more landlords in Adedenkpo and Old Fadama reported being aware, this differed in Gbegbeyise where more renters than landlords claimed to be aware of the same (Table 5.8). Furthermore, it was also found from focus group meetings that, some community members considered the development regulations to be cumbersome. This view is exemplified by a discussant in Gbegbeyise who noted that:

I do not know how they [government] expect us to follow all those complicated regulations before we put up our buildings. They [the regulations] are unnecessarily complicated and unrealistic (Participant #3, General Focus Group, Gbegbeyise).

An Officer responsible for Building Inspection during an interview in June 2017 also admitted to the concerns of the respondents, when he said:

We are supposed to enforce development regulations, although they are cumbersome. Aside from the difficulty for lay people to understand, they [regulations] require too much from developers. People do not know that with even for the renovation and refurbishment of a building, one needs a permit, also for your own demolishing of your property (Interviewee, #I12).

The finding that some landlords lacked in the knowledge of regulations does suggest why some of the property owners in this study may not have complied with such regulations.

Table 5.6: Percentage of Tenants and Landlords Who Are Aware of Development Permitting Regulations

Settlement/community and awareness of regulations			Residential tenancy status		Total
			Landlord	Renter/tenants	
Adedenkpo	I am aware/I know	N	29	13	42
		%	31.5	23.2	28.4
	I do not know	N	63	43	106
		%	68.5	76.8	71.6
	Total	N	92	56	148
		%	100.0	100.0	100.0
Ga-Nshonaa	I am aware/I know	N	24	0	24
		%	17.4	0	17.4
	I do not know	N	114	0	114
		%	82.6	0	82.6
	Total	N	138	0	138
		%	100.0	0	100.0
Gbegbeyise	I am aware/I know	N	17	25	42
		%	26.2	30.9	28.8
	I do not know	N	48	56	104
		%	73.8	69.1	71.2
	Total	N	65	81	146
		%	100.0	100.0	100.0
Old Fadama	I am aware/I know	N	13	1	14
		%	11.4	2.8	9.3
	I do not know	N	101	35	136
		%	88.6	97.2	90.7
	Total	N	114	36	150
		%	100.0	100.0	100.0

Source: Author's construct, based on the household survey

Perception of corruption was also reported about the enforcement of development regulatory processes in the study communities. This was implied by a staff member of the City Authority, who said:

The issue is that because of the bureaucratic processes that applications pass through, most of the building owners hide behind somebody [known power broker] and go ahead with the construction. What we try to do is that, once we want revenue to develop the AMA jurisdiction, we try to regularise the whole thing [developing without a permit] and make sure that we do it smoothly so that the building owner can pay [unapproved development permit fees]. We should have known that, if we burden them [developers] with many documents, it will send them away to put up illegal structures everywhere (Interviewee #I4).

Altogether, the inability of many respondents to comply with regulations, coupled with their threats of eviction, have meant that respondents' dwellings are not built to withstand climate change-related hazards such as excessive heat and flooding. This finding has also been reported in similar other studies in Asia (Jabeen, Johnson & Allen 2010; Wamsler & Brink 2014) and Latin America (Wamsler & Brink 2014).

Moreover, it was found that some residents developed their dwellings on waterways, encroached on water bodies as well as obstructed other households' access to ventilation as was observed during fieldwork (also shown in Figure 5.3, details of which are shown Appendix 11). This encroachment is in spite of the background that the national building regulations (L.I 1630, 1992) [in Part 1 Section (7)] state that “*no person shall construct any building on a plot unless the building abuts an approved street or the site of an approved street for a distance of at least 3 meters*”. Such crowded living conditions and encroachment on water bodies tend to worsen the impact of excessive heat and flooding, as reported in similar other studies in Africa (Isunju, Orach & Kemp 2015), Asia (Jabeen, Johnson & Allen 2010) and Latin America (Wamsler & Brink 2014).

Figure 5.3: Encroachment on Waterways in Gbegbeyise between 2000 and 2017



Source: Author's construct based on maps obtained from Google maps, May 2017

Furthermore, by the establishing regulations (institutions) [section 64 (6) of the Local Government Act of 1993 (Act, 462)], the local authorities must obtain eviction notices from the courts before removing unauthorised developments or structures in the city. However, it was found that residents were concerned about arbitrary eviction activities resulting from the enforcement of land use and zoning regulation by the city authorities. This view is illustrated by a resident of Adedenpko who noted that:

I want to say they [city authorities] should leave us in peace and everything will be fine here. Some people may be able to buy land and build houses while others may not be able, but we are all human beings. So when we eventually die and we are buried, our graves will eventually be our houses. There is no work here to do, and I am married with children. I also have parents to take care of. How will I take care of all of them? Previously I had five rooms here renting, and I got money from that, but now everything has been pulled down. They [city authorities] say the land is [meant] for a road. First, Vanderpuye [then Mayor of Accra] demolished my rooms. Next, they [city authorities] came to demolish my shop, while leaving those of other people. What does the AMA expect from me and my family? (Participant #4, General Focus Group, Adedenpko).

Added to the evictions by the local authorities for non-conformity with land use regulations, was the view that the eviction activities were also influenced by the increasing demand on land for commercial development purposes. An example of this opinion was expressed by a resident in Ga-Nshonaa, who said that:

Oh, as for government, this land just like the others has been sold to a company. The last time, we saw Chinese [a group of Chinese nationals] surveying the land, and we will soon be evicted. It will not be used for any landing beach for fishermen, but a hotel. Every unused land is now being sold to foreigners (Participant #8, General Focus Group, Ga-Nshonaa).

This problem has also been reported among residents of informal settlements in studies conducted in other developing countries (Chatterjee 2010; Isunju, Orach & Kemp 2015; Wamsler & Brink 2014). Isunju, Orach & Kemp (2015) reported that residents of informal settlements in Kampala were vulnerable to flooding partly due to a prevalent unfavourable development regulatory framework in the city. The residents' exposure was also exacerbated by the increasing need for land for development purposes, which compelled them to live in crowded conditions without basic drainage amenities, and in flood prone locations.

5.3.2 Access to Decision-making and Control over Resources

Access to decision-making processes and control over resources is important in building a households' capacity to respond to vulnerabilities associated with climate change-related hazards (Bohle 1984; Smith 2004). However, urban households' and communities' entitlement and access to commonly owned resources are often constrained by the prevalent institutional and political arrangements (Bulkeley & Betsill 2013). In the context of Accra, Ghana's Local Governance Act, Act 462 (1993) [Section 46] and the National Development Planning Systems Act, Act 468 (1994), require local authorities to adopt participatory and inclusive planning processes in the planning and delivery of public amenities in cities. In spite of this legislation, survey results show differences in perception of political marginalisation among respondents in the case study settlements; no respondent in Ga-Nshonaa and or Old Fadama felt they were involved in the city's governance. This contrasts with over 17.5 percent of respondents in Gbgbeyise, and much higher (40.5 percent) in Adedenpko, who felt they were involved in the governance of the city. An example of the perception of exclusion was stated in Ga-Nshonaa by a participant who related their community's bad relations with the city authorities when he said: "*the only time we see AMA Officials here is when they come to harass us. They [city officials] have never come to ask us what we need as a community*" (Participant #4, General Focus Group, Ga-Nshonaa).

Furthermore, it was found from this study the local authorities' engagement of the study communities was distinguished according to their land ownership. This was implied in the statement of a Development Planning Officer of Accra City Authority when he opined that:

We have a very healthy relationship with those settlements that we call indigenous communities that have gone through several years of deprivation and are now slums. We take note of their needs, and as and when necessary, we provide. However, those that are illegal, like the Sodom and Gomorrah, Mensah Guinea, the June Fourth, and all those places [squatters]; those, we do not [have a healthy relationship] (Interview #13).

In terms of the length of stay of a household, 57.1 percent of the respondents in Adedenpko who perceive that they were involved in the governance of the city had also lived there for a period of 20 to 30 years (Table 5.7). The percentage was lower in the case of Gbegbeyise, where 23.2 percent of the respondents reported to have lived there for less than ten years. However, the proportions of respondents in each study community claiming to have been involved in the governance of the city (Accra) were mostly higher among respondents with longer stay periods in the same communities (Table 5.7). Altogether, the findings support those of another study which reported that new entrants who migrated to informal settlements (Magbara and Supraghat) in Khulna (Bangladesh), felt more excluded from the city's governance (Roy, Hulme & Jahan 2013). Moreover, although migrants in both Magbara and Supraghat were excluded from the voter's register, the effect of this political exclusion was reportedly more pronounced in Magbara. Residents in Magbara were found to have had more difficulties in getting their voices heard in deciding on service provision in the city and their community, increasing their exposure to climate change-related hazards.

Table 5.7: Percentage Respondents Who Perceived Themselves as Involved in Governance by Length of Stay in the Study Settlements

Settlement/community and involvement in governance		Percentage in length of stay in community/settlement				Total	
		Less than ten years	10-20 years	21-30 years	Over 30 years		
Adedenkpo	Yes	N	15	5	12	28	60
		%	32.6	35.7	57.1	41.8	40.5
	No	N	31	9	9	39	88
		%	67.4	64.3	42.9	58.2	59.5
Ga-Nshonaa	Yes	N	0	0	0	0	0
		%	0	0	0	0	0
	No	N	81	57	0	0	138
		%	100	100	0	0	100
Gbegbeyise	Yes	N	16	3	2	5	26
		%	23.2	11.1	13.3	14.3	17.8
	No	N	53	24	13	30	120
		%	76.8	88.9	86.7	85.7	82.2
Old Fadama	Yes	N	0	0	0	0	0
		%	0	0	0	0	0
	No	N	3	75	72	0	150
		%	100	100	100	0	100

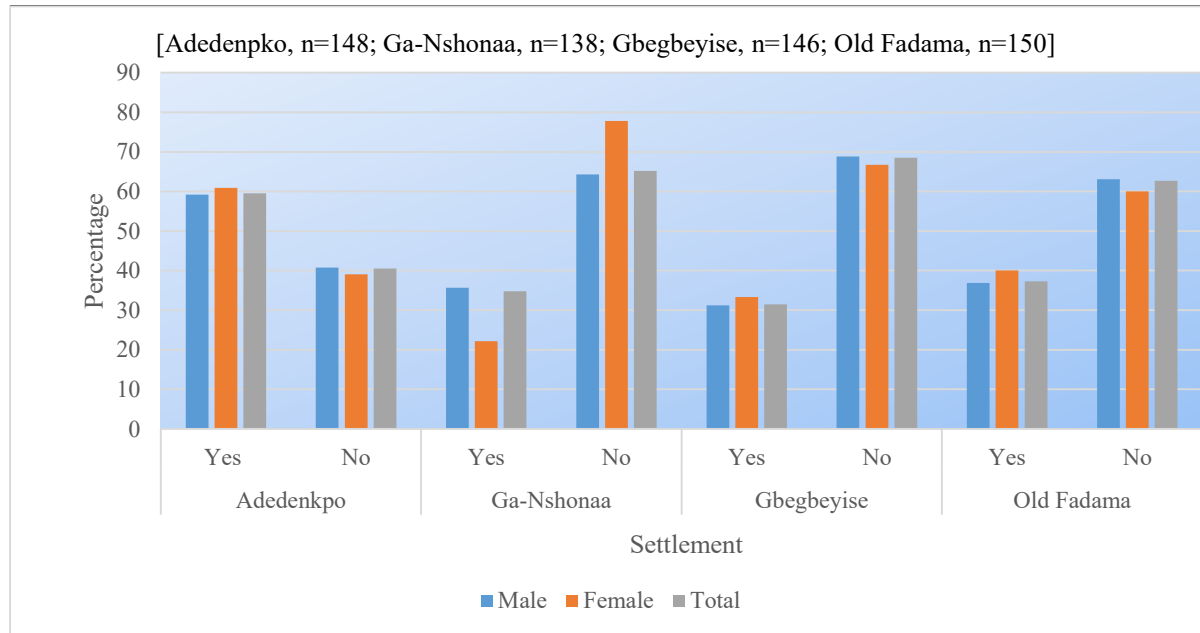
Source: Author's construct, based on the household survey

It has also been argued that the nature of and distribution of social capital also influence people's involvement in governance and their exposure to climate change-related hazards (Adger 2010). Understanding social capital as the benefits which arise to a person by belonging to a group, a head of household's membership of a group may manifest as a means of support in times of hazards in a community. In spite of this recognition, the survey results show that only Adedenkpo (59.5 percent) had majority respondents claiming to belong to groups, although over a quarter of respondents in each of Ga-Nshonaa (34.8 percent), Gbegbeyise (31.5 percent) and Old Fadama (37.3 percent) also reported so. These findings can be understood in the context of the ethnic composition and longevity of the study communities. Residents of Adedenkpo are mainly ethnic 'Ga' who had settled in their community for a longer period. By contrast, residents of Ga-Nshonaa and Old Fadama are a mixture of ethnic groups of squatters.

Nevertheless, significant gender-related differences were not noticeable among the respondents' associational lives in the study communities, with the exception of Ga-Nshonaa (Figure 5.4). This finding contrasts with that of Farouk and Owusu (2012) who reported from their study that women in informal settlements in Accra are more often involved in the formation of solidarity groups than men. It can thus be argued from these findings that, the

associational lives of the respondents is gendered, but not optimal in generating communal benefits for the majority of respondents to reduce their exposure to climate-related hazards.

Figure 5.4: Percentage of Respondents Who Belonged to Groups According to Gender



Source: Author's construct, based on the household survey

In summary, the finding from this study shows that residents of the informal settlements in this study were excluded from the planning process based on tenure security considerations. The differences in exclusion affect availability to communal infrastructure and residents' exposure to climate change-related hazards. This is similar to findings reported from other studies in Accra (Afenah 2009; Amoako, 2014; Grant 2009). For instance, Afenah's (2009) study reported that the current land ownership regime in Accra has become primarily important in defining urban citizenship in the city. Similarly, Jabeen, Johnson and Allen (2010) reported from their study in Dhaka (Bangladesh) that, this nature of tenure security has often influenced informal settlements' residents' access to public resources, including infrastructure and the related exposure and vulnerability to climatic hazards.

5.3.3 Access to Basic Social Services and Quality of Dwelling Conditions

Access to quality housing, infrastructure, and services is crucial in building households' resilience for reducing their vulnerability to climate change-related hazards in urban areas (Dodman, Bicknell & Satterthwaite 2012; Satterthwaite 2008; While & Whitehead 2013). Moreover, household and communal infrastructure and amenities such as dwelling unit, including water, sanitation (toilet) and waste collection are considered important for the general wellbeing and vulnerability of urban dwellers to environmental hazards. Despite this recognition, results from the survey in Table 5.8 show that different types of housing exist in the study areas, but the nature of housing conditions was generally poor and spatially different. Most respondents in Ga-Nshonaa (84.1 percent) and Old Fadama (71.3 percent) were found living in temporal (make-shift) dwellings, compared to a reported predominance of compound houses in Adedenpko (70.9 percent) and Gbegbeyise (69.2 percent). By sharing dwelling spaces in compound houses (a building built around a common courtyard, with shared facilities), Farouk and Owusu (2012) reported from their study that, the residents are often prone to contamination of their water sources, and to the spreading of flooding-related diseases and various ailments.

The results further show that the value of housing to the respondents included the provision of space for economic activities. Most respondents (69.6 percent in Ga-Nshonaa, 52 percent in Gbegbeyise, 58 percent in Old Fadama) claimed they mainly worked within their settlement boundaries. This finding of the use of housing for home-based businesses is similar to the outcomes from other studies such as Cissé & Sèye (2015) in Dakar (Senegal) and Huq & Alam (2003) in Dhaka (Bangladesh). Despite this importance of housing, through observation, materials used to construct the dwellings were found to be of poor quality and dwelling units did not show evidence of regular maintenance with visible decay (see Plate 5.2). Such dilapidated dwellings exposed the study respondents to climate-related hazards such as excessive heat, fire outbreaks and flooding.

Table 5.8: Type of Dwelling by Respondents and their Location of Work

Settlement/community and location of work			Type of housing/dwelling					Total
			Compound House	Semi-detached	Detached	Temporal structure(kiosk, container, others)	Other	
Adedenkpo	Work within community	N	53	3	0	15	0	71
		%	50.5	37.5	0	42.9	0	48.0
	Work outside community	N	52	5	0	20	0	77
		%	49.5	62.5	0	57.1	0	52.0
	Total	N	105	8	0	35	0	148
		%	70.9	5.4	0	23.6	0	100.0
Ga- Nshonaa	Work within community	N	0	10	2	82	2	96
		%	0	55.6	100.0	70.7	100.0	69.6
	Work outside community	N	0	8	0	34	0	42
		%	0	44.4	0.0	29.3	0.0	30.4
	Total	N	0	18	2	116	2	138
		%	0	13.0	1.4	84.1	1.4	100.0
Gbegbeyise	Work within community	N	56	10	1	9	0	76
		%	55.4	47.6	50.0	40.9	0	52.1
	Work outside community	N	45	11	1	13	0	70
		%	44.6	52.4	50.0	59.1	0	47.9
	Total	N	101	21	2	22	0	146
		%	69.2	14.4	1.4	15.1	0	100.0
Old Fadama	Work within community	N	13	10	0	64	0	87
		%	54.2	52.6	0	59.8	0	58.0
	Work outside community	N	11	9	0	43	0	63
		%	45.8	47.4	0	40.2	0	42.0
	Total	N	24	19	0	107	0	150
		%	16.0	12.7	0	71.3	0	100.0

Source: Author's construct, based on the household survey

Apart from the type of dwelling and its physical conditions, availability and quality of basic amenities and infrastructure play a major role in the living conditions of urban residents. These factors influence the general wellbeing of the household, including exposure to and their ability to minimise the impacts of climate change-related hazards. Survey results show that availability of social amenities was found to vary partly in relation to land ownership arrangements in the various localities (Table 5.9). Most of the respondents reported to often access drinking water from public standpipes in Adedenkpo (62.8 percent) while fewer (18.9 percent) claimed to often purchase water from commercial water points (Plate 5.3). Comparatively much fewer (18.2 percent) reported to often access water within their compounds in Adedenkpo (Table 5.12). In contrast, no household reported having access to home water connection in Ga-Nshonaa. Respondents from Gbegbeyise were found to be similar to those from Adedenkpo where most households (58.2 percent) claimed to often buy water from vendors, while fewer (31.5 percent) claimed to use water from ‘public-use and pay’ stand-pipes. Furthermore, about

a tenth (10.3 percent) of the respondents in Gbegbeyise, reported having access to the most preferred option of water (water connection into their homes).

Results from Old Fadama were found to be similar to Gbegbeyise in terms of the nature of access to in-house/in-yard water connection. Less than 1 percent of respondents (0.7 percent) reported in-house/in-yard water connection, while most of the respondents (87 percent) claimed to often buy water from water vendors. Similarly, fewer (13 percent) respondents claimed to often access water from privately-owned public stand-pipes in Old Fadama. Resulting from this was a common concern raised by the residents that the water they purchased was extremely high priced. This view is indicated by a focus group participant in Old Fadama who noted that:

...we are fed up with the high cost of water in this community. A gallon of water costs only 30 pesewas in other parts of Accra, but here in Old Fadama, we pay about GH¢1 cedi for the same quantity. This is too expensive (Participant # 4, General Focus Group, Old Fadama).

The finding that water supplied through informal processes is highly-priced has also been reported from similar studies in Bangladesh (Akbar et al. 2007). When this result is compared to the rest of Accra, 31.8 percent of the city's population had water connected into their homes (GSS, 2014). This disparity in service provision can be further understood in the context of the implementation of cost recovery-based service provision by the State of Ghana, following the adoption of measures aimed at structural economic reforms (discussed in Chapter Two). Overall, the nature of water accessed by households and the need to transport this over distances has been found to influence the increased contraction of air-borne diseases in similar studies in Africa (Cissé & Sèye 2015; Douglas et al. 2008) and Asia (Huq & Alam 2003).

Table 5.9: Access to Amenities by Respondents

Settlement/ community		The main source of water as percentage (%) within community			Main mode of accessing toilet as percentage (%) within community				Main mode of solid waste disposal as percentage (%) within the community						
		Public standpipe	Commercial water points	Household connection	Public toilet	Neighbour's toilet	Seashore/open space	Private toilet	Drains	Seashore/bush	Burning	Dump in Skip Container	Personal bin for collection	Informal community	Other
Adedenkpo	N	93	28	27	115	4	0	29	5	9	1	16	60	54	3
	%	62.8	18.9	18.2	77.7	2.7	0.0	19.6	3.4	6.1	0.7	10.8	40.5	36.5	2.0
Ga-Nshonaa	N	34	104	0	115	0	23	0	0	22	18	0	1	50	47
	%	24.6	75.4	0.0	83.3	0.0	16.7	0.0	0.0	15.9	13.0	0.0	0.7	36.2	34.1
Gbegbeyise	N	46	85	15	129	3	1	13	3	8	3	40	2	79	11
	%	31.5	58.2	10.3	88.4	2.1	0.7	8.9	2.1	5.5	2.1	27.4	1.4	54.1	7.5
Old Fadama	N	19	130	1	148	0	0	2	0	26	26	0	0	36	62
	%	12.7	86.7	0.7	98.7	0.0	0.0	1.3	0.0	17.3	17.3	0.0	0.0	24.0	41.3

NB: Summation is 100% under each category of amenity in a community [Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

Plate 5.1: Exposed Water Line and Temporal Structures in Old Fadama



Source: Photograph by author, July 2017

Plate 5.2: Public Water Point in Adedenkpo



Source: Photograph by author, July 2017

Access to sanitation (toilet) facilities among the respondents is also poor in the study settlements compared to the rest of the residents of Accra, as shown in Table 5.9. It was found that, while a relatively lower (41.9 percent) percentage of residents in Accra accessed public latrines (GSS 2014), most respondents in Adedenkpo (77.7 percent), Ga-Nshonaa (83 percent), Gbeggbeyise (88 percent), and Old Fadama (98.7 percent) claimed to often access commercial public toilets (Table 5.9) (as shown in Plate 5.3). Added to this, a few households in Adedenkpo (2.7 percent) reported the use of a neighbour's toilet (Table 5.9). In comparison, usage of private-in-house toilet was higher among respondents in Adedenkpo (20 percent). This finding may be understood by the fact that most of the respondents in Adedenkpo had recognised security of tenure by the city authorities relative to Old Fadama (only 1 percent) which is a squatter settlement.

Respondents, therefore, reported having to usually trek over long distances as well as form long queues at the point of access to toilets. This view was reported by a focus group discussant in Old Fadama who said that:

....in this community, although there are many toilets, they are just too few for all of us. Where I live, sometimes I spend up to one hour of my time to go to the toilet alone. This is because, sometimes we have to form queues to wait for others at the toilet (Participant # 4, General Focus Group, Old Fadama).

A significant share of time is thus spent by households to access basic needs in the study communities. This affects the time that is often available to households for engaging in economic activities, and for children of school going ages for their education. Compared to the rest of residents of Accra, where 33 percent have access to in-house toilet facilities (GSS 2014), the above situation suggests an uneven distribution of sanitation services in Accra (Table 5.9).

Resulting from the limited access to safe sanitation facilities, some respondents in Ga-Nshonaa (17 percent) and Gbegbeyise (1 percent), reported often defecating openly. This becomes an environmental hazard when in contact with climate change-related hazards such as flooding, creating health challenges as reported from a study conducted in other informal settlements in Accra (Owusu, Agyei-Mensah & Lund 2008).

Plate 5.3: Public Toilet in Old Fadama



Source: Photograph by author, July 2017

Availability of waste collection was also found to be poor and spatially distinguished in the various communities. A total of up to 36 percent of the respondents in each of Adedenkpo and Ga-Nshonaa and more than half of the respondents in Gbegbeyise (56 percent) reported the use of informal waste collectors. This proportion was comparatively lower in Old Fadama (24 percent). Compared to the rest of Accra, 59 percent of Accra's residents access 'door-to-door' waste collection services (GSS 2014). The seeming recognition of residents of Adedenkpo by the city authorities may have accounted for the high proportion of respondents (41 percent) reporting to have access to a formalised waste collection arrangement. This view is further supported by community members during focus group meetings in Adedenkpo when one said:

...I will say we are very lucky in this community. We have cordial relations with AMA, and we cannot say we have been left out of their work. They have provided us with a door-to-door waste collection service organised with a private company. The only problem is that the company does not come here very regularly. However, this problem is not caused by AMA (Participant #2, General Focus Group, Adedenkpo).

In contrast, residents of Old Fadama were concerned about the repeated efforts they made towards the local authorities to provide waste collection bins to their community. The reported efforts were often ignored on the grounds of their lack of official legitimacy as a community. This position was expressed by a focus group participant who noted that:

...we made several efforts to AMA, to give us just one centralised waste collection container to put in our waste for disposal. They [AMA] refused to do it. However, we do not eat waste, so people throw it where ever they can (Participant #5, General Focus Group, Old Fadama).

Put together, it can thus be inferred that the legitimacy accorded to Gbegbeyise and Adedenkpo by the local authorities, may have accounted for the allocation of waste collection services to only those two out of four case study settlements. Residents of other informal settlements have also reported the effect of this indiscriminate garbage disposal and widespread use of poorly maintained public latrines on their health conditions (Huq & Alam 2003). Overall, the findings support the assertion by Brown, McGranahan and Dodman (2016) that "*urban informality, both in the informal economy and in informal settlements, is often associated with low pay and high exposure to environmental hazards*" (p.5) as further presented in the next section.

5.4 Most Frequently Experienced Climate Change-Related Hazards

The survey results show a differentiated exposure of the respondents to their most frequently experienced climate change-related hazards (Table 5.10). Responses on the 'perceived' most

frequent climate change-related hazard in this study, were based on the commonly reported hazards in the literature: heat, flooding, fire outbreaks, storms, sea-level rise and coastal erosion (IPCC 2002), all of which are also prevalent in Accra. The time scope for assessment covered the last one to two years.

As shown in Table 5.10, survey results were geographically differentiated. Over three-quarters of the respondents in Old Fadama (76.7 percent), compared to less than three-quarters of respondents in Adedenkpo (66.2 percent), Gbegbeyise (67.1 percent), and Ga-Nshonaa (65.9 percent) perceived temperature rises and extremes, as their most frequently experienced climate change-related hazard of concern. In terms of tenancy status of the respondents, a marginally higher percentage of landlords than tenants in each of the three study communities, excluding Old Fadama, reported this concern. However, no known reason was adduced from this finding; further analysed as part of respondents' overall perceived vulnerability in section 5.6 of this chapter.

Following temperature rise was flooding, the perception of which was marginally differentiated among respondents in Adedenkpo (16.9 percent), Gbegbeyise (18.9 percent), Ga-Nshonaa (13.7 percent) and Old Fadama (12.7 percent). In contrast to excessive heat, a marginally higher percentage of tenants than landlords in three of the study communities, excluding Ga-Nshonaa, reported this concern (Table 5.10).

Plate 5.4: Ripped off Roofs in Adedenkpo



Source: Photograph by author, July 2017

Plate 5.5 Flooding After Normal Rain in Ga-Nshonaa



Source: Photograph by author, July 2017

A perception that storm (rainstorm/windstorm) is one of the most frequent climate change-related hazards of concern was also reported by between four (4) percent and 13 percent of respondents of the various study communities. Over a tenth (13 percent) of respondents from Gbegbeyise, as compared to only 4 percent of respondents in Old Fadama held this perception (Table 5.10). Similar to flooding, marginally higher percentage of tenants than landlords in three of the study communities, excluding Ga-Nshonaa, reported storm (rainstorm/windstorm) as a concern (Table 5.10). Following flooding are each of saline water intrusion, coastal erosion and fire hazards also variously reported to be of the main concern among relatively fewer (less than five (5) percent) of the respondents in each case study community (Table 5.10).

The finding on the increase in fire outbreak as a climate-related hazard in Old Fadama has also been reported by Farouk and Owusu (2012) in their study in Accra. In general, fire hazards tend to destroy properties in many informal settlements in Africa (Pelling & Wisner 2012). This may be understood in the context of the congested nature of the study communities, and the difficult access to fire tendons from the Ghana Fire Service Department in times of fire outbreaks given that most dwellings in these settlements are constructed with combustible materials (as shown in plate 5.2).

Moreover, while respondents from Old Fadama and Adedenpko did not report coastal erosion and sea-level rise concerns, these were the main concerns for many respondents from Gbegbeyise and Ga-Nshonaa as displayed in Table 5.10. Altogether, temperature rises and excessive heat, flooding and storms were reported to commonly occur and of concern, in all the four study communities, but their perceived frequency and impacts were varied among the respondent households. This finding supports the view of Cannon (2004) that exposure and vulnerability to climate change-related hazards differ not only among different people of different socio-economic and political characteristics but also between space and time.

Table 5.10: Most Frequently Experienced Climate Change-Related Hazards According to Tenancy Status of the Respondents

Settlement/community			Most frequent climate-related hazard experienced as percentage (%) within community							Total
			Temperature and excessive heat	Fire outbreaks	Coastal Erosion	Sea level Rise	Saltwater intrusion	Flooding	Storms (rainstorm/windstorm)	
Adedenkpo	Landlord	N	65	4	0	0	4	13	6	92
		%	70.7	4.3	0	0	4.3	14.1	6.5	100.0
	Renter/tenant	N	33	2	0	0	2	12	7	56
		%	58.9	3.6	0	0	3.6	21.4	12.5	100.0
Total	N	98	6	0	0	6	25	13	148	
	%	66.2	4.	0	0	4.1	16.9	8.8	100.0	
Ga-Nshonaa	Landlord	N	91	2	2	2	4	25	12	138
		%	65.9	1.4	1.4	1.4	2.9	18.1	8.7	100.0
	Total	N	91	2	2	2	4	25	12	138
		%	65.9	1.4	1.4	1.4	2.9	18.1	8.7	100.0
Gbegbeyise	Landlord	N	46	2	1	0	0	9	7	65
		%	70.8	3.1	1.5	0.0	0	13.8	10.8	100.0
	Renter/tenant	N	52	2	2	2	0	11	12	81
		%	64.2	2.5	2.5	2.5	0	13.6	14.8	100.0
Total	N	98	4	3	2	0	20	19	146	
	%	67.1	2.7	2.1	1.4	0	13.7	13.0	100.0	
Old Fadama	Landlord	N	87	4	0	0	5	14	4	114
		%	76.3	3.5	0	0	4.4	12.3	3.5	100.0
	Renter/tenant	N	28	1	0	0	0	5	2	36
		%	77.8	2.8	0	0	0.0	13.9	5.6	100.0
Total	N	115	5	0	0	5	19	6	150	
	%	76.7	3.3	0	0	3.3	12.7	4.0	100.0	

Source: Author's construct, based on the household survey

Further findings from focus group meetings in the study localities revealed the variety of perceived impacts of climate-related hazards to the respondents as shown in Table 5.11. For instance, experience in headache was associated with temperature changes, malaria and fever. This, in turn, was reported to affect affected persons' livelihood activities since they are unable to work. Also, flooding was perceived to lead to the breeding of mosquitoes, which were reported to often bite residents, in turn causing malaria to the victims. Malaria is a disease, which involves cyclical infection of humans and *Anopheles* mosquitoes, as vectors of a parasite, and commonly found in informal settlements in Africa (Jallow et al. 2009).

Apart from malaria and other health impacts, flooding was also reported to destroy residents' property such as production assets, while coastal erosion was reported to often destroy fishing

canoes. Moreover, rising sea levels were associated with an increase in the destruction of fishing canoes in the shoreline communities (Table 5.11).

Table 5.11: Attributed Impacts of Climate Change-Related Hazards in the Study Settlements

<ul style="list-style-type: none"> • Temperature causes severe heat, malaria, headache, fever, and skin rashes. • Annual floods destroy property. • Temperature changes and changes in rainfall patterns have been reported to affect fish catch. • Fire outbreaks destroy our dwellings, property and economic activities. • Rains affect working time and pollute water sources. • Annual rain and wind storms rip off roofs of buildings and destroy fishing canoes. • Coastal erosion and sea level rise making it more difficult to land their canoes, while the associated currents carry away the canoes from the shore. • Tidal waves destroy homes and affect work. • Rising sea level has been displacing households and destroying canoes on an annual basis. • Salty groundwater affects buildings and water sources.

Source: Focus Group Discussions in the four study communities

Survey results further provide insights into the ranking of the attributed impacts of climate-related hazards in the study communities (Table 5.12). It was found that the impacts were geographically dissimilar, with most respondents in Adedenkpo (63 percent), Ga-Nshonaa (40.6 percent) and Old Fadama (52 percent), perceiving the health of their households as the most important losses. By contrast, the higher percentage of respondents in Gbegbeyise viewed their livelihood activity (32.2 percent) or health (32.9 percent) as the most important losses (Table 5.12). A seeming peculiarity of the reported impacts of the hazards was the loss of life of a household member to flooding in Gbegbeyise (Table 5.11). Unexpected downpour that occurred on June 3, 2015, in Accra (Issah 2015) was reported to have accounted for this death.

In terms of tenancy status, a relatively higher proportion of tenants than landlords in Adedenkpo (63.6 percent to 62.6 percent) and Old Fadama (58.3 percent to 50 percent) considered their health as the most important asset affected. In contrast, more landlords than tenants considered their housing as the most significant asset affected by climate change-related hazards in the same communities, except Adedenkpo (18.7 percent landlords compared to 25.5 percent tenants) (Table 5.12). The lack of ownership of property among tenants could have accounted for this relatively lower rating of housing among renter-households than landlord households. Moreover, tenants, especially when they are migrants as in this study, tend to be pre-occupied with their survival needs and the need for remittance to their places of

origin. Overall, however, this finding is contrary to the often suggested view (example, Moser 2011), that housing is the most important item of the urban poor in times of hazards.

Table 5.12: Perceived Most Important Thing Affected By Climate Change-Related Hazards by Tenancy Status

Settlement/community and Effects of Climate Change			Tenancy Status		Total	
			Landlord	Renter/tenants		
Adedenpko	Health	%	62.6	63.6	63.0	
	Housing	%	18.7	25.5	21.2	
	Production assets	%	0.0	1.8	0.7	
	Livelihood activity	%	18.7	9.1	15.1	
	Total	N		91	57	148
		%		100.0	0	100.0
Ga-Nshonaa	Health	%	40.6	0	40.6	
	Housing	%	30.4	0	30.4	
	Production assets	%	14.5	0	14.5	
	Livelihood activity	%	14.5	0	14.5	
	Total	N		138	0	138
		%		100.0	0	100.0
Gbegbeyise	Health	%	38.5	28.4	32.9	
	Housing	%	20.0	19.8	19.9	
	Production assets	%	10.8	17.3	14.4	
	Lives	%	0.0	1.2	0.7	
	Livelihood activity	%	30.8	33.3	32.2	
	Total	N		65	81	146
%			100.0	100.0	100.0	
Old Fadama	Health	%	50.0	58.3	52.0	
	Housing	%	23.7	13.9	21.3	
	Production assets	%	18.4	22.2	19.3	
	Livelihood activity	%	7.9	5.6	7.3	
	Total	N		114	36	150
		%		100.0	100.0	100.0

Source: Author's construct, based on the household survey

Plate 5.6: Poor Housing Conditions in Adedenkpo



Source: Photograph by author, July 2017

Plate 5.7: Poor Housing Conditions in Old Fadama



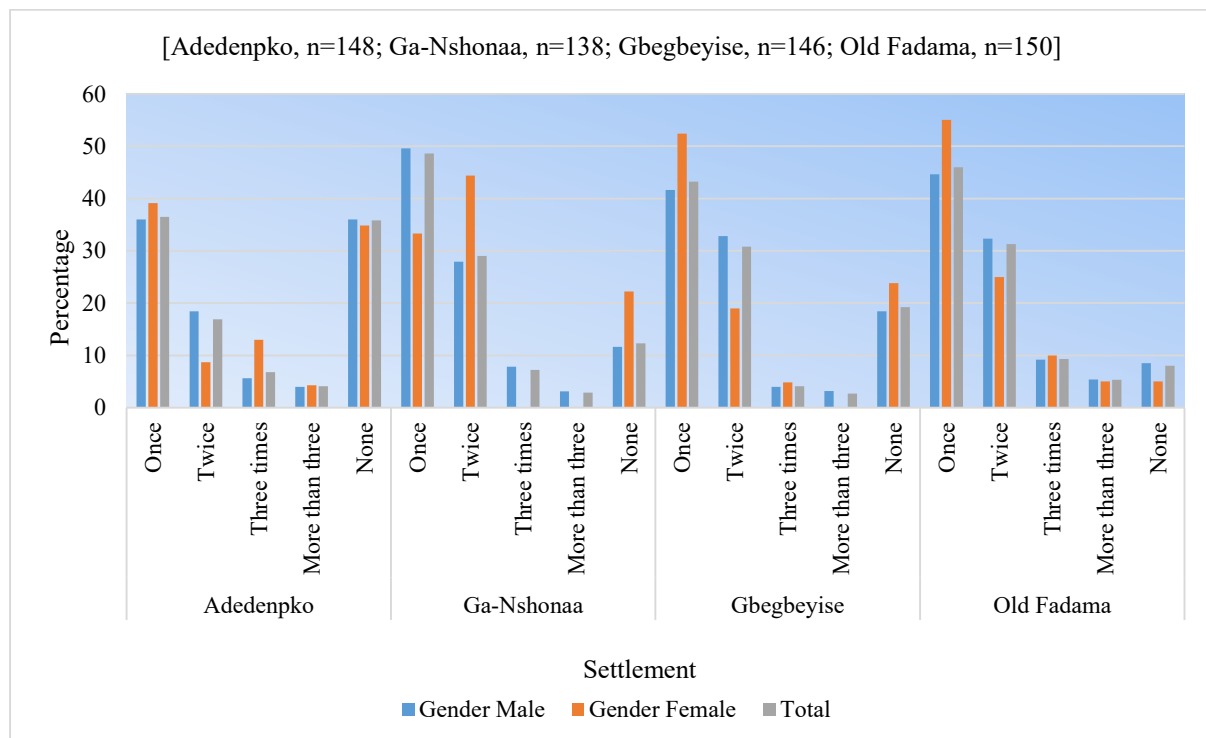
Source: Photograph by author, July 2017

5.5 Unhealthy Conditions and Ill-health

Results from the survey also revealed some differences between and within the study areas in terms of the nature of the respondents' reported health conditions. Figure 5.5 shows that the highest percentage of respondents in Adedenkpo (36.5 percent), Ga-Nshonaa (48.6 percent), Gbegbeyise (43.2 percent), and Old Fadama (46.0 percent) reported falling ill at least once in a year. However, the respondents who also reported 'no illnesses' every year were even more markedly different; 35.8 percent in Adedenkpo as compared to less than a tenth (8 percent) in Old Fadama reported this. Nevertheless, these percentages were much lower than those who reported illness of different frequencies in a year, as shown in Figure 5.5.

Also, Figure 5.4 shows that marginally higher percentages of female respondents than male respondents reported falling ill once or twice in a year compared to significantly higher proportion (over 20 percent in each case study settlement) reporting 'no illnesses' in a year for the same gender groups. It can thus be argued that the socio-economic, political and institutional contexts of the respondents had differentially exposed them to climate change-related hazards. Similar assertions have been made in other studies in informal settlements in Africa (Douglas et al. 2008; Katukiza et al. 2014), Asia and Latin America (Wamsler & Brink 2014).

Figure 5.5: Reported Frequency of Illness in a year by Gender Status of the Respondents



Source: Author's construct, based on the household survey

5.6 Factors Associated with Perceived Vulnerability to Hazards

A notable view on vulnerability has been offered by Adger (2006), who asserts that vulnerability is context-specific and often uniquely perceived by those who experience it. Moreover, Renn et al. (1992) had earlier offered a similar perspective by noting that:

...events pertaining to hazards interact with social, institutional, and cultural processes in ways that can either heighten or attenuate individual [or group of individuals in a household] and social perceptions of risk and shape risk behaviour or response (p.137).

Considering these perspectives, this study following after Isunju, Orach and Kemp (2016), while departing from the dominant researcher-oriented ontology of political ecologists, examines the drivers associated with ‘perceived vulnerability’ of the respondents. The responses were based on study respondents’ perception of whether their households are “vulnerable”, or “not vulnerable” within their socio-economic, political, institutional and ecological/climatic contexts. Therefore this research focused on integrated vulnerability to social and biophysical climatic factors, as a state.

As shown in Table 5.13, results from the survey show that at least half (50 percent) of respondents in each study community perceived their households to be “vulnerable”, and to climate-related hazards. Nevertheless, the perception of vulnerability was geographically differentiated; it was only a little over half (50.7 percent) of respondents in Adedenkpo while much higher proportions in Gbegbeyise (67.8 percent), Ga-Nshonaa (96.4 percent) and Old Fadama (98.7 percent) reported so. Conversely, higher proportions of respondents from Adedenkpo (49.3 percent) and Gbegbeyise (32.2 percent) than each of Ga-Nshonaa (3.6 percent) and Old Fadama (1.3 percent) perceived themselves as “not vulnerable”.

Table 5.13: Respondents’ Perceived Vulnerability to Hazards

Settlement/community		Perception of vulnerability as percentage (%) within the community		Total
		Vulnerable	Not Vulnerable	
Adedenkpo	N	75	73	148
	%	50.7	49.3	100.0
Ga-Nshonaa	N	133	5	138
	%	96.4	3.6	100.0
Gbegbeyise	N	99	47	146
	%	67.8	32.2	100.0
Old Fadama	N	148	2	150
	%	98.7	1.3	100.0

Source: Author's construct, based on the household survey

Although survey respondents related their vulnerability to several factors as discussed in earlier parts of this chapter, to some respondents who perceived themselves as “not vulnerable”, the idea of feeling vulnerable is perceived negatively. This is exemplified by a survey respondent who noted that:

I will not say we are vulnerable. We are not poor people. Once we have sound health to work and a place to lay our heads, it will serve no purpose to sit here and lament over what we do not have (Questionnaire #23, Adedenpko).

On the other hand, recognising their vulnerability is viewed by the respondents differently. Many of the respondents justified this perception, as necessary to inspire them to take action on their situation. This is exemplified by a respondent in Old Fadama who noted that:

We cannot pretend all is well with us here. We do not have basic services here, and all these floods, heat and mosquitoes are added on to make life very difficult. We need help in this community (Questionnaire #17, Old Fadama).

Nevertheless, the exact socio-economic, political, institutional and climatic-related factors that are associated with this ‘perceived vulnerability’ remained unknown. However, such knowledge is important for evidence-based policy formulation in planning a response to integrated vulnerability in informal settlements in Accra.

Determining the exact drivers associated with respondents’ perceived vulnerability, bivariate and multivariate regression analyses were conducted, as was done by Isunju, Orach and Kemp (2016). The crude odds ratios (CORs), adjusted odds ratios (AORs) and levels of significance, generated are shown in Appendix 6 and Appendix 7.

Socio-economic, political and institutional factors/drivers of respondents’ vulnerability considered in these analyses were age, gender, ethnicity, educational level, residential tenancy status, incomes, household size, and length of stay of the respondents’ households. Other factors are the perception of ‘threats of eviction’, belonging to a group, perception of involvement in the city’s governance, and knowledge of development regulations. Added to the socio-economic, political and institutional factors were the climatic hazards to which respondents were exposed. Together, these factors are viewed to have an influence on respondent’s vulnerability, including climatic hazards (Appendix 6). While these parameters share commonalities with those considered by Isunju, Orach and Kemp (2016) (age, gender, marital status, occupation, length of stay, household size, monthly expenditure, tenancy, and exposure to floods), they are unique from the factors of vulnerability that had previously been empirically analysed in the known literature.

The survey results show that tenancy status, their length of stay, a perception of ‘threats of eviction’ over their land, as well as the income category to which a household belongs, were statistically significantly associated with their perceived vulnerability at the bivariate level. Specifically, tenants (COR 2.345, 95 percent CI 1.092-5.035, $p=0.029$), were more likely than landlords to be vulnerable, possibly due to their inferior property rights to take action on their dwellings.

Furthermore, respondents who stayed in the community for at least between 10 years to 20 years (COR 2.93, 95 percent CI 1.170-7.35, $p=0.022$) similar those who stayed for above 30 years, were less likely to perceive themselves as vulnerable compared to respondents who lived for less than 10 years (COR 1.567, 95 percent CI 0.706-3.479, $p=0.27$). In general long-term residents may have a comparatively higher potential to develop their social network, thus accumulate social capital thereof.

In addition, households’ income distribution was associated with their perceived vulnerability including to climatic hazards; respondents who earned less than GH¢7000 per annum (COR 0.455, 95 percent CI 0.200-0.988, $p=0.047$) were more likely than those who earned higher incomes to perceive themselves as vulnerable (Appendix 6). Moreover, respondents who perceived ‘a threat of eviction’ (COR 3.370, 95 percent CI 1.787-6.357, $p=0.000$) on their land, were more likely to perceive themselves as ‘vulnerable’ than those who did not feel ‘a threat of eviction’ (Appendix 7). A perceived or real ‘threat of eviction’, does not provide a secure environment for the affected households to respond to their vulnerabilities (Roy, Hulme & Jahan 2013).

Further analyses involved multivariate analyses of only statistically significant variables at the bivariate level. Results show that the most significant factor associated with the respondents’ perceived vulnerability was their ‘threats of eviction’ (AOR 3.592, 95 percent CI 1.973-6.539, $p=0.000$) (Appendix 7).

The finding which suggests a relationship between the tenancy status and a household’s ‘perceived vulnerability’ was similar to findings from a study conducted by Isunju, Orach and Kemp (2016) in Uganda. This may be understood in the context of the different property rights that are prevalent in the four study communities. Generally, property owners who do not usually need permission before carrying out structural changes to their buildings tend to be more likely ‘vulnerable’ to climatic hazards in informal settlements as reported in other studies (Isunju, Orach & Kemp 2015; Jabeen, Johnson & Allen 2010; Roy, Hulme & Jahan 2013).

Nevertheless, factors such as age, gender, ethnicity, level of education, head of a household's membership of a group, the location of their work, were not statistically significantly associated with their perception of vulnerability. In addition to these, factors such as respondents' awareness of building regulations, perception about their involvement in the governance of the city were not associated with their perceived vulnerability. Overall, the physical, climatic hazards to which respondents were exposed, were also not statistically significant. This finding is contrary to that of Isunju, Orach and Kemp (2016) who reported residents' exposure to flood hazards as the most significant factor associated with their perceived vulnerability, at the multivariate level of analyses.

5.7 Conclusion

This chapter has unravelled the drivers of 'perceived vulnerability' to hazards among residents of four informal settlements in Accra: Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama. The findings are as experienced, perceived and contextual to the respondents of the four study settlements. Broadly, the chapter shows that patterns of differentiated vulnerability to climate change-related hazards among residents of the four different informal settlements are not only as a result of biophysical climate-related hazards. Rather, the respondents' vulnerability is differentially accounted for by a suite of socio-economic, political and institutional factors within their communities', Accra and Ghanaian contexts.

Moreover, the 'perceived vulnerability' as determined through the lenses of the respondents in this study shows that key drivers associated with their exposure to climate change-related hazards excluded the biophysical climate change-related hazards themselves. However, socio-economic, political and institutional-related factors of tenancy status, perception of 'threats of eviction' over their land, as well as the income category to which the households belonged, were found to be statistically associated with their 'perceived vulnerability'. Nevertheless, the most significant factor found to have been associated with the respondents' perceived vulnerability is 'threats of eviction' over their land.

The nature of land ownership among the respondents from the four study communities may have accounted for this significance of 'threats of eviction' among the drivers of their perceived vulnerability. It was found that planning staff of the Accra City Authority are also guided by the nature of this tenure security in planning for service provision, thereby systemically excluding residents who lacked formal security of tenure from the planning process in the city.

Doing so has the potential to further perpetuate the patterns of differentiation in vulnerabilities among and within the various informal settlements to climate change in Accra. Nevertheless, it has long been noted that individuals' perceptions and knowledge about environmental risks, do influence their capacity and decisions to respond to the same (Renn et al. 1992). The nature of the respondents' perceptions and knowledge about climate change in the four study settlements are presented in the next chapter.

6 CHAPTER SIX: PERCEPTIONS AND KNOWLEDGE OF CLIMATE CHANGE

6.1 Introduction

This chapter presents the study's findings and discussions relating to the respondents' perceptions and knowledge of climate change as influenced by their socio-economic, political and institutional contexts. The chapter is a presentation of the answer to the second main thesis question: In which way does the context of residents of informal settlements influence their knowledge and capacity to respond to potential climate change in Accra? Three embedded questions that are also answered in this chapter are: 1) what are the perceptions of climate-related environmental changes among residents of informal settlements and the potential synergies with scientific knowledge on climate change-related phenomena? 2) how do socio-demographic characteristics of residents of informal settlements influence their knowledge of climate change compared to the perspectives of state officials on the same? and 3) how does the socio-political context of residents of informal settlements influence their access to and nature of an early warning on climate change-related hazards?

Responses to these questions are based on a household survey and further elaborated on with findings from focus groups discussions in the four study communities. Since state officials are responsible for managing climate change-related knowledge and early warning on disasters in the city, results from interviews conducted with state officials are integrated with findings from the survey in different sections of this chapter.

The chapter shows three main findings. Firstly, the respondents' perceived changes in climate change related-phenomena were mostly in synergy with scientific data on the same. Secondly, educational levels of the respondents were associated with their knowledge of the causes of climate change, but thirdly, the majority of the respondents perceived state disaster management institutions as not performing optimally. Therefore, differences in socio-economic characteristics and access to early warning information on climate change-related hazards have had a differential effect on the respondents' capacity to respond to climate change in the case study settlements.

The rest of this chapter is structured into four sections. The first section focuses on the perceptions of the respondents on observed long-term environmental changes, compared with meteorological data on Accra. This shows the nature of potential climate change and variability as perceived by the study respondents. Following this, the influence of the respondents' socio-demographic characteristics on their knowledge of climate change is presented in the second section. Section three of the chapter covers the nature of early warning on climate change in the four study settlements.

6.2 Perception of Long-term Environmental Changes and Scientific Data

Peoples' perception about environmental risks to which they are exposed influences their decision to respond to such risks (Bankoff & Hilhorst 2013). Yet, while a household's ability to forecast climate change-related events is necessary for them to respond to extreme events (Naess 2013), the extent to which this knowledge can be integrated with scientific knowledge would depend upon the potential synergies between the two. This section of the chapter presents the study's findings on the respondents' views on environmental changes which are often associated with climate change/variability: temperature changes, rainfall patterns, coastal erosion, sea level rise, saltwater intrusion, and flooding (IPCC 2003). To assess the potential synergies with scientific data, the survey results are compared with data collected on climate-related variables from the Ghana Meteorological Agency for Accra. In some instances, where climatic data is lacking, this comparison has been done with relevant scientific publications.

6.2.1 Perceived Changes in Temperature

As shown in Table 6.1, most (between 80.7 percent and 100 percent) respondents in each of the study settlements reported a perception of changes/increases in temperature, which is consistent with scientific data on Accra (also shown in Figure 6.1). Respondents holding this perception were geographically differentiated; all respondents (100 percent) in Gbegbeyise compared to only 80.7 percent in Old Fadama, perceived so. Nevertheless, the survey results show that this view was not associated with the length of stay of the respondents in any of the four study communities (Table 6.1). Moreover, findings from focus group meetings in the four study communities were consistent with the survey findings. This is exemplified by a participant in Adedenpko who noted that:

For some time now, we have been experiencing very high, and scorching temperatures both during daytime and at night. But this is more seriously felt between December and March (FGD# 6, General Focus Group, Adedenpko).

Table 6.1: Percentage of Respondents who Perceived Changes in Temperature by Length of Stay in the Study Settlements

Settlement/community			Length of stay in years				Total
			Less than 10 yrs.	10-20 yrs.	21-30 yrs.	Over 30 yrs.	
Adedenpko	There has been a change	N	46	14	21	66	147
		%	100	100	100	98.5	99.3
Ga-Nshonaa	There has been a change	N	71	44	0	0	115
		%	87.7	77.2	0	0	83.3
Gbegbeyise	There has been a change	N	69	27	15	35	146
		%	100.	100	100	100	100
Old Fadama	There has been a change	N	2	62	57	0	121
		%	66.7	82.7	79.2	0	80.7

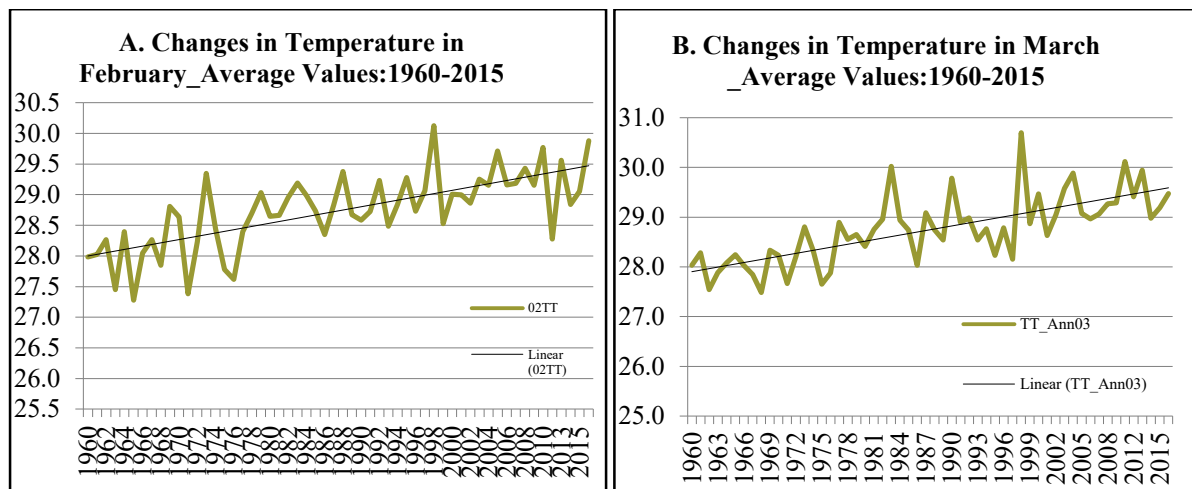
[Adedenpko, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

Also important in determining how people may respond to climate change is their knowledge about when climate change-related events do occur (Gifford, Kormos & McIntyre 2011). The study thus sought to determine the respondents' perception of the timing of the different climatic variables in Accra. Survey results show that most respondents (between 77 percent and 83.3 percent in the four study communities) perceived temperature changes to take place during December to March each year; 77 percent in Adedenpko, 77.5 percent in Ga-Nshonaa, 82.9 percent in Gbegbeyise and 83 percent in Old Fadama reported so (Table 6.2). However, fewer (less than 12 percent) of the respondents in each study settlement perceived temperature increases as taking place in April to August in a year; or were not sure of the timing (less than 8 percent in each case) of these increases. This is similar to the less than six (6) percent of the respondents in each of the case study communities which held the perception that temperature changes were throughout the year.

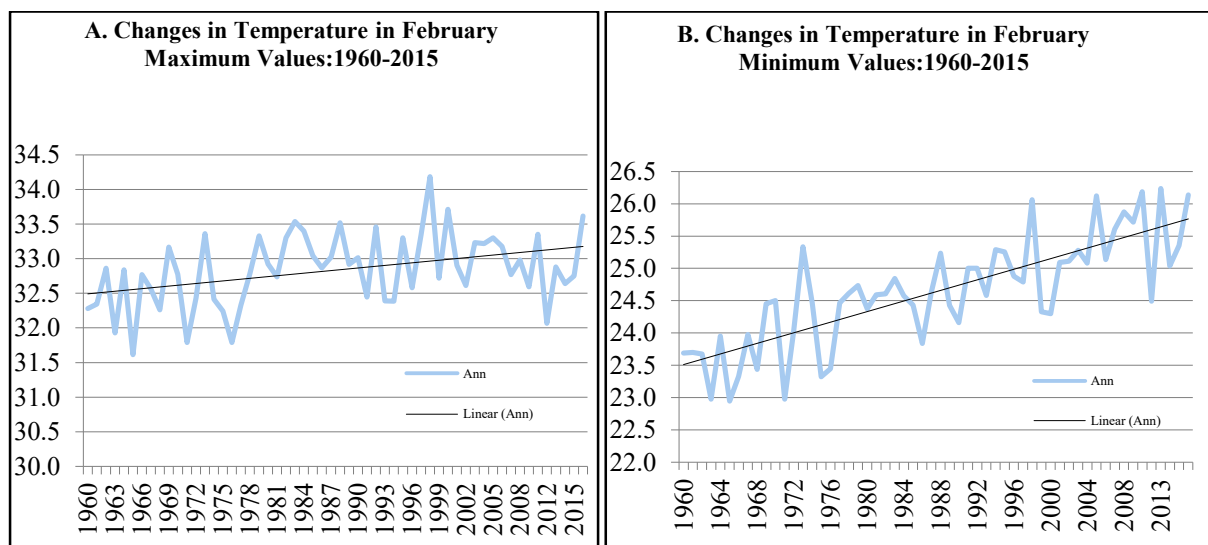
Analysis of data from the Ghana Meteorological Agency for February and March reveals a consistency of scientific data with the predominant perception held by the respondents on temperature increases in Accra (Figure 6.2). Figure 6.2 shows that both total monthly temperature (the magnitude) and temperature range (the maximum and minimum levels) indicate changes in temperature over 55 years (1960 to 2015).

Figure 6.1: Changes in Temperature in Accra in Degrees Celsius in February and March: 1960-2015



Source: Author’s construct based on data collected from Ghana Meteorological Agency in June 2017

Figure 6.2: Monthly Maximum and Minimum Temperature in Degrees Celsius, February (1960-2015)



Source: Author’s construct based on data collected from Ghana Meteorological Agency in June 2017.

6.2.2 Perceived Changes in Rainfall Patterns and Less Predictability

Changes in rainfall patterns (onset and ending periods) were also perceived among most (between 97.3 percent and 98.6 percent) respondents in all the four study communities (Table 6.1). This view was similarly held among respondents in Adedenpko (97.3 percent), Ga-Nshonaa (97.8 percent), Gbegbeyise (98.6 percent) and Old Fadama (98.0 percent) (Table 6.1). Similarly, no marked differences were noticeable relative to the length of stay of the

respondents who held this perception. It was also found, as shown in Appendix 10 Table 4, that most respondents (82.4 percent in Adedenkpo, 82.6 percent in Ga-Nshonaa, 87.7 percent in Gbegbeyise and 87.3 percent in Old Fadama) perceived the timing of rainfall as between the period of May to October each year (the period of rainfall in Accra as shown in Figure 6.2).

Nevertheless, fewer (less than 7 percent in each case study settlement) respondents perceived the period of rainfall as November to April in each year. Additionally, the percentages who reported being unsure of the timing of rainfall were relatively higher than those who reported the timing as from November to April in each year (Appendix 10 Table 4). Moreover, comparatively lower percentages of respondents reported the timing of rainfall as ‘throughout the year’ in all the study communities (Appendix 10 Table 4).

Table 6.2: Percentage of Respondents who Perceived Changes in Rainfall Patterns and/or Intensity by Length of Stay in the Study Settlements

Settlement/community			Length of stay				Total
			Less than 10 yrs.	10-20 yrs.	21-30 yrs.	Over 30 yrs.	
Adedenkpo	There has been a change	N	45	13	21	65	144
		%	97.8	92.9	100.0	97.0	97.3
Ga-Nshonaa	There has been a change	N	80	55	0	0	135
		%	98.8	96.5	0	0	97.8
Gbegbeyise	There has been a change	N	68	26	15	35	144
		%	98.6	96.3	100.0	100.0	98.6
Old Fadama	There has been a change	N	2	74	71	0	147
		%	66.7	98.7	98.6	0	98.0

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author’s construct, based on the household survey

Findings from the survey were supported during focus group meetings in all the study communities. This is exemplified by the comment of a community member in Adedenkpo who noted that:

In the past, rainfalls were immediately preceded by strong winds, but nowadays, it is not always like that in June. Because the timing has changed. Unexpectedly one would see the rain falling. Mostly in other months (Participant #5, Focus Group, Adedenkpo).

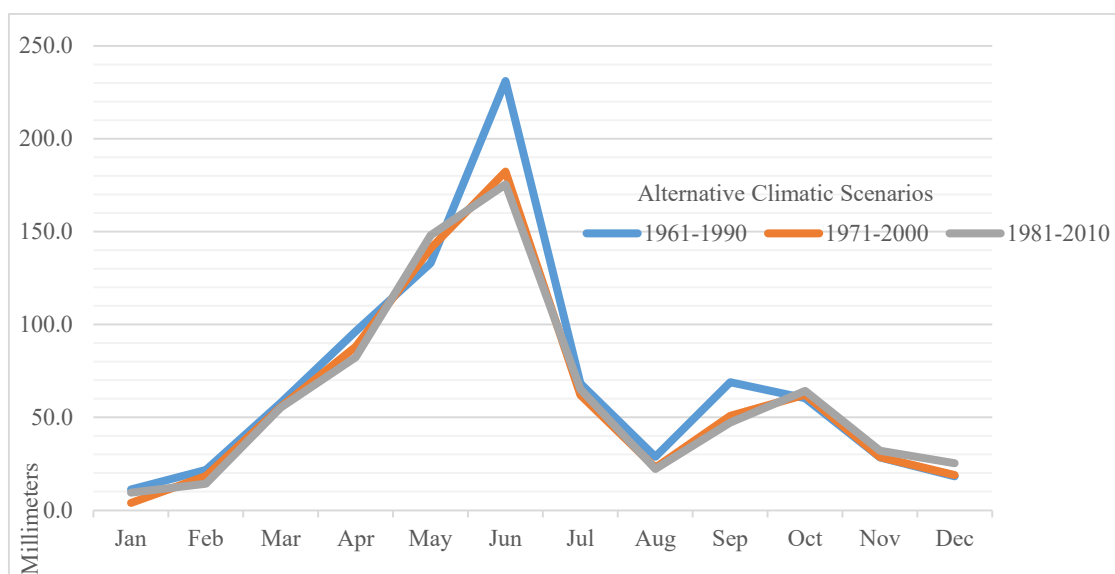
The findings of changes in rainfall patterns were consistent with views expressed during an interview with a representative of Ghana Meteorological Agency when he noted that:

The onset date on the average has become late - September has become an important month for rainfall. And we also have early seizures on the average, which also translate to shorter rainy seasons. This is expected to continue (Interview #17).

Overall, the above quotes do show consistency between the study respondents' perceptions and scientific data pointing to changes in the onset and seizure period of rainfall in Accra.

Furthermore, the reported changes in rainfall by the respondents in this study, when compared with scientific data do indicate a minor shift in the patterns of rainfall in Accra (depicted in Figure 6.3). It is shown in Figure 6.3 that, average annual rainfall for a climatic period of 1961 to 1990 was approximately 824.4 millimetres, but was lower at approximately 735.5 millimetres if the climatic scenario was assumed from 1971 to 2000. Furthermore, Figure 6.3 shows that, average monthly rainfall volumes had fallen in June for a climatic period of 1971 to 2000 and for 1981 to 2010 scenario when compared to the 1961 to 1990 scenario.

Figure 6.3: Average Monthly Rainfall in Millimetres for three Alternative Climatic Scenarios from 1961 to 2010 in Accra



Source: Author's construct based on data collected from Ghana Meteorological Agency in June 2017

Added to the oscillation of the rainfall values, Figure 6.3 shows a bimodal rainfall regime of a major rainy season and minor rainy season for Accra. It is shown that, while the peak period of the major rainy season is in June for all the three alternative climatic scenarios that of the minor rainy season has minimally shifted from September to October for the 1981-2010 scenario. In terms of volumes of rainfall, a new average monthly lower of 64.2 millimetres is also observed when compared to 68.9 millimetres of rainfall in the 1961 -1990 climatic scenario. Noteworthy is the fact that the two annual rainy seasons in Accra are interspersed by a dry period from November to February and in August. This finding is consistent with the predominant view that is held by most respondents on the timing of rainfall (May to October)

(Appendix 10 Table 4). Overall, the finding that informal settlements' residents in this study are aware of minor changes in the rainfall patterns in Accra is consistent with Douglas et al. (2008)'s in their study in Alajo community in Accra. This emphasises

6.2.3 Perceived Changes/Increase in Coastal Erosion, Sea level rise, and Saltwater

Intrusion

It has also been found that over 80 percent of the respondents in Ga-Nshonaa (95.7 percent) and Gbegbeyise (87 percent) reported a perception of a change/increase in coastal erosion, or sea level rise (96.4 percent and 89 percent respectively). In contrast, the perception of changed/increased saltwater intrusion was markedly and spatially differentiated among the respondents; as much as 83 percent in Ga-Nshonaa, compared to only 3.3 percent in Old Fadama reported so (Appendix 10, Table 5). These differences are accounted for by the locational differences of the communities; Ga-Nshonaa and Gbegbeyise are shoreline communities, while Old Fadama is an inland community. Moreover, residents of inland communities are comparatively less regularly exposed to coastal erosion which may have made them less concerned about this. However, there was no noticeable relationship between the length of stay of the respondents and their perception of changes in sea level rise, coastal erosion and saltwater intrusion in any of the four study communities as shown in Appendix 10 Table 5.

The perception that coastal erosion had increased is consistent with the findings from a scientific study that was conducted by Appeaning-Addo and colleagues (2011). The scholars estimate the incidence at 1.13 meters/year \pm 0.17 meters/year. They further suggest that future erosion will affect large swaths of land that is presently occupied by many residents along the western shoreline of Accra.

Similarly, the finding which shows that most respondents in the shoreline communities perceive changes/increases in sea levels is supported by a scientific study conducted by Appeaning-Addo et al. (2011). The scholars estimated sea levels to rise at 2 millimetres/year in Accra. Moreover, this rise in sea levels, coupled with winds and strong waves of 0.5meters/second and 1.5 meters/second, has been associated with coastal erosion in Accra (Appeaning Addo & Adeyemi 2013). That of a reported perceived increase in groundwater salinity is also supported by a scientific study that was conducted by Kortatasi and Jorensen (2001) in Accra.

6.2.4 Perceived Changes in Flooding

The survey results further show that most (at least 72 percent) respondents in Adedenkpo, Ga-Nshonaa, Gbegbeyise and Old Fadama (79.1 percent, 84.1 percent, 76.0 percent and 72 percent, respectively), perceived increases in the frequency of flooding in their communities (Appendix 10 Table 5). Although this view is unsupported by scientific data on Accra, it differed among respondents of the various communities; it was highest in Ga-Nshonaa (84%) and lowest in Old Fadama (72%). However, similar to findings on sea level rise and coastal erosion, the perception of a change in flooding was not associated with the length of stay of the respondents in the study communities (Appendix 10 Table 5).

Moreover, most respondents perceived the period of occurrence of flooding in their communities, as from May to October each year. Up to 82.4 percent in Adedenkpo, 82.6 percent in Ga-Nshonaa, 87.7 percent in Gbegbeyise and 85 percent in Old Fadama, reported this (Appendix 10, Table 4). Of the rest of the respondents, fewer (less than 7 percent in each community) perceived this as the period of November to April each year; and a similar percentage (less than 8 percent) reported ‘not being sure’ of the time of flooding in each community. Furthermore, a relatively much smaller percentage (less than 6 percent) in all the four study communities reported flooding to take place throughout the year (Appendix 10, Table 4). Overall, most respondents’ view on the timing of flooding, was found to have coincided with the period of rainfall in Accra as shown in Figure 6.3 (April to September each year) (Appendix 10, Table 4). Nevertheless, the claim that flooding has increased in the four study communities could not be substantiated as there was no means for tracking this claim. Thus, the reported increase in flooding by the respondents remain only as perceptions.

Table 6.3: Percentage of Respondents who Perceived Changes/Increase in Flooding by Length of Stay in the Study Settlements

Settlement/community				Length of stay				Total
				Less than 10 yrs.	10-20 yrs.	21-30 yrs.	Over 30 yrs.	
Adedenkpo	Floods	There has been a change	N	35	14	17	51	117
			%	76.1	100.0	81.0	76.1	79.1
Ga-Nshonaa	Floods	There has been a change	N	70	46	0	0	116
			%	86.4	80.7	0	0	84.1
Gbegbeyise	Floods	There has been a change	N	50	23	14	24	111
			%	72.5	85.2	93.3	68.6	76.0
Old Fadama	Floods	There has been a change	N	2	55	51	0	108
			%	66.7	73.3	70.8	0	72.0

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author’s construct, based on the household survey

This is against the backdrop that, studies conducted by scholars in Accra suggest a reduction in rainy days from about 90 days to fewer than 80 days per annum over four decades (Rain et al. 2011). It is therefore noteworthy, that a reduction in rainy days and the volume of rainfall in Accra, together suggest that respondents' reported increases in flooding may have been accounted for by other factors other than climate change. Other scholars have also reported this finding in their studies in Accra (Amoako & Frimpong Boamah 2015; Amoako & Inkoom 2018; Karley 2009). Karley (2009), asserts that:

Clearly, there is no evidence that unusual rainfall has been occurring recently that could explain the increased occurrences of flooding being experienced. Rather, the cause of the problem is lack of drainage facilities to collect stormwater for safe disposal in Accra (p.25).

This finding highlights the need for climate change adaptation scholarship to pay attention to the differences between community perceptions and the actual evidence on climatic phenomena.

6.2.5 Perceived Changes/Increase in Storms (rainstorms/ windstorms)

Increasing storms were also perceived by at least 89.1 percent of the respondents in all the study settlements (Table 6.4), although unsupported by scientific data on Accra (Figure 6.4). The magnitude of this perception was similarly held among respondents in the study communities. Most respondents in Adedenpko (89.2 percent), Ga-Nshonaa (89.1 percent) and Old Fadama (89.3 percent), but a higher percentage (93.8 percent) in Gbegbeyise, reported a perception of an increase in storms (Appendix 10, Table 4). Moreover, similar to flooding and temperature, this perception was not associated with the length of stay of the respondents (Table 6.4).

In terms of timing of occurrence of storms, most respondents (atleast 81 percent in all study communities) perceived this as occurring from May to October each year. Following this is less than a tenth of respondents in each settlement who perceived the same as from November to April each year, while less than six percent in each settlement was not sure of the timing. The least percentage (less than five percent) in each case study community claimed storms occurred throughout the year (Appendix 10, Table 4). However, only the view of the majority of respondents in this study is consistent with the period of rainfall in Accra, given that storms (rain/windstorms) occur in the period of rainfall, as shown in Figure 6.4.

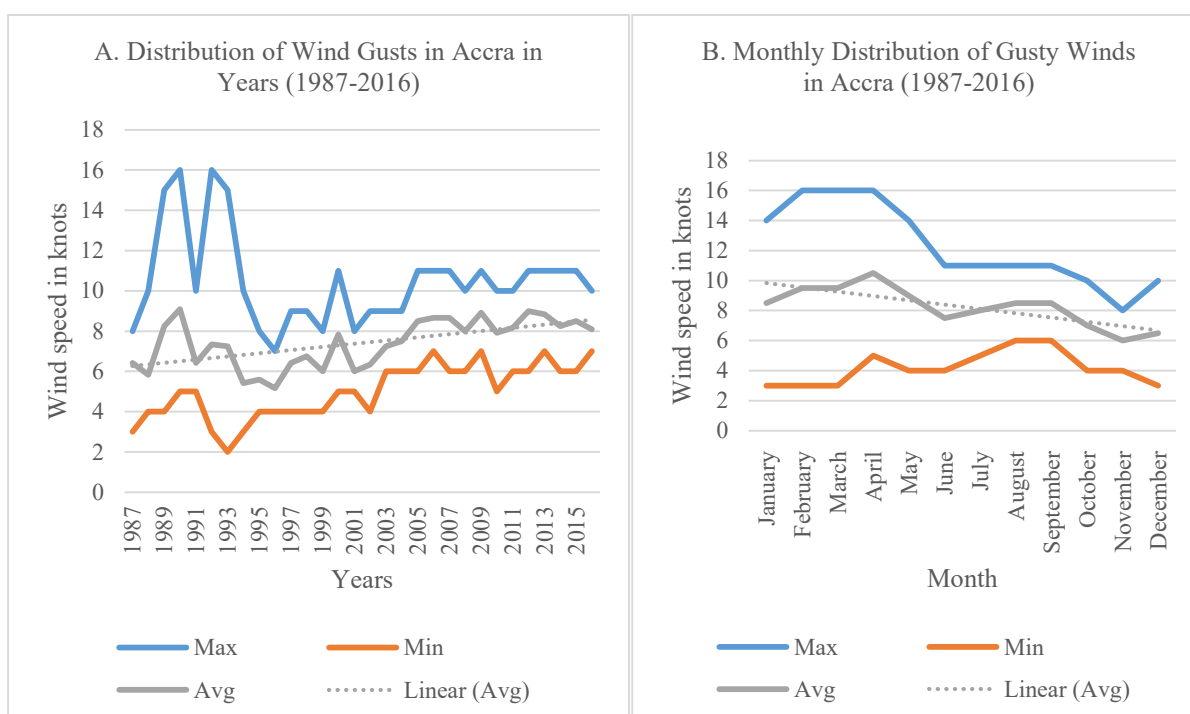
Table 6.4: Percentage of Respondents who Perceived Changes in Storms by Length of Stay in the Study Settlements

Settlement/community				Length of stay				Total
				Less than 10 yrs.	10-20 yrs.	20-30 yrs.	Over 30 yrs.	
Adedenkpo	Storms	There has been a change	N	40	13	21	58	132
			%	87.0	92.9	100.0	86.6	89.2
Ga-Nshonaa	Storms	There has been a change	N	71	52	0	0	123
			%	87.7	91.2	0	0	89.1
Gbegbeyise	Storms	There has been a change	N	65	24	15	33	137
			%	94.2	88.9	100.0	94.3	93.8
Old Fadama	Storms	There has been a change	N	3	65	66	0	134
			%	100.0	86.7	91.7	0	89.3

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author’s construct, based on the household survey

Figure 6.4: Distribution of Gusty Winds in Accra (1987-2016)



Source: Author’s construct based on data collected from Ghana Meteorological Agency in June 2017

Further examination of data on wind gusts related to storms over 30 years (1987-2016) shows the distribution occurred more in April, August and September each year, as shown in Figure 6.4.B. However, Figure 6.4.A also shows that the average wind speed has remained steady over the same period. It is also noteworthy that, the period April to July also tends to mark the major rainy season, and September to November the minor season in Accra (Figure 6.3). It is further shown in Figure 6.4 that the magnitude of gusty winds tends to lower in November and are less

in the dryer month of January and February compared to other months in a year in Accra. Together, these results suggest evidence of increases in the intensity and frequency of windstorms over the period 1987 to 2016, in concordance with most survey respondents in this study.

6.2.6 Synthesis: Concordance between Perceptions and Scientific Sources

A synthesis of the perceptions of the respondents and scientific sources shows both concordance and discordance between the two (Table 6.5). It is shown in Table 6.5 that, respondents' perception of a change in temperature is consistent with scientific data on Accra. Both night and daily maximum temperature values have increased, as was also reported during focus group meetings in the study communities.

Table 6.5: Concordance between Perceptions and Scientific Sources

Climate variable	Perceptions and knowledge	Trends in scientific data	Synergies
Temperature	Day and night temperatures have risen in all settlements.	Day and night temperatures have risen.	Perceptions and formal data are in agreement on temperature rise both at night and day.
Rainfall patterns and intensity	Delays in onset, less rain in the peak of June, July and unpredictability in June, July and August.	Delays in onset by a few weeks in March, a new peak in October. Significant reductions in amounts in June.	There is an agreement between perceptions and scientific data on delays in onset, less predictability, and reduction in volumes of rain in June.
Saltwater intrusion	While many households believe in changes in water salinity, this has not been experienced by many.	Scientific studies offer evidence of increasing water salinity.	There is concordance between perceptions of residents and scientific studies on saltwater intrusion in Accra.
Flooding	Reported predominant perception of an increase in floods in all settlements.	There is no flooding knowledge specific to local communities, hence no basis for comparison.	While flooding relates to rainfall, the many intervening factors involved in transforming rains to floods are not easily observable to compare the perceptions with scientific data.
Storms (rain/wind storms)	There is a predominant perception of increasing storms (rain and wind storms) in all settlements.	Wind distribution over 1987-2016 suggests a steadily increasing trend.	There is an agreement in the timing of distribution of winds and evidence to support increasing wind intensity.
Coastal erosion and sea-level rise	While many households do not directly experience coastal erosion, their long period of exposure to it allows them to report its increases.	Scientific studies offer evidence of coastal erosion	Perceptions and scientific data are in concordance, showing coastal erosion and rising sea levels.

Source: Author's synthesis based on the survey, focus groups, interviews and climate data

Secondly, respondents' perceptions of changes in rainfall patterns are also consistent with scientific data on Accra. It is shown that the onset period for rainfall in the minor rainy season has seemingly shifted slightly to October (Table 6.7).

Thirdly, the respondents' reported increase in coastal erosion, storms and sea-level rise have been somewhat consistent with scientific studies on Accra. However, the claim by respondents that flooding frequency had increased remains unsupported by scientific studies on the same. Overall, the finding of concordance between perceptions of the respondents and meteorological data on temperature and rainfall changes, are similar to findings from a study that was conducted in northern Ghana (Dickinson et al. 2017). In their study, Dickinson et al. (2017) reported consistency in survey respondents' perceptions with meteorological data on both temperature and rainfall patterns over 35 years. This suggests the importance of noting the differences between local perceptions and scientific facts on different climatic variables in planning for responding to climate change.

Furthermore, it was found that a household's length of stay in a community was not associated with the respondents' knowledge of climate change-related variables. This finding contrasts with the often suggested relationship between the longevity of residents' stay as associated with their knowledge about changes in their environment, as by Orlove et al. (2010). However, the finding that the respondents' knowledge about changes in their environment was also associated with their location, does support the view that perceptions about environmental risks are location-specific. The finding emphasises the importance of considering people's location and perceptions in urban risks analysis.

6.3 Influence of Education and Age on Perception and Knowledge of Climate Change

This section examines how the educational qualifications and ages as social variables of the respondents, may have influenced their perception of climate change. Generally, individual's such as household heads' socio-demographic factors - especially age and educational status - do influence their knowledge about climate change (Terry 2009). Moreover, the education level and age of a person influence his/her level of access to work and resources that are required for accessing relevant climate-related early warning information.

6.3.1 Perception of Climate Change and Variability

Results from the household survey show that at least 97.3 percent of the respondents in each study community perceived a relationship between observed local environmental changes and

climate change/variability (Appendix 10 Table 6). However, the differences were not significant among the respondents of the various communities: 97.3 percent in Adedenpko, 98.6 percent in Ga-Nshonaa, 98.6 percent in Gbegbeyise and 97.3 percent in Old Fadama reported so. Similarly, there were no marked differences relative to respondents' educational levels and this perception (Appendix 10 Table 6). However, the proportions of respondents without education who held this perception were higher than among all categories of literate respondents in Adedenpko, Ga-Nshonaa and Gbegbeyise.

In contrast, the proportions without education were marginally lower than those with educational qualifications in Old Fadama, who perceived this link between local environmental changes and climate change (Appendix 10 Table 6). Overall, however, there was no relationship between the respondents' educational levels and their predominant perception that there is a relationship between local environmental changes and climate change in the study communities (Appendix 10 Table 6). This finding is contrary to that of Wamsler et al. (2012), who reported a strong association between the educational levels of residents and their knowledge about their environment and climate change in Los Manantiales (El Salvador) and Rocinha, Rio de Janeiro (Brazil).

Furthermore, as indicated in Table 6.6, the survey results also show that there was no relationship between the ages of the respondents and their perceptions of climate change. Between 92.7 percent and 100 percent of the respondents of all ages in all the study communities reported this (Table 6.6). This finding does not support that of Jabeen, Johnson and Allen (2010) among the respondents in their study. The scholars reported from their study in Korail, Dhaka that older respondents were more aware of changes in rainfall patterns than younger community residents. This was due to their longer stay and familiarity of the latter with their environment.

Put together, the higher levels of respondents who perceived some relationship between climate change/variability and their perceived environmental changes may also be associated with ongoing education on climate change/variability in the study communities (see Plate 6.1). For example, Climate Change Clubs have been reportedly formed in the Ga-Mashie area, which includes the study settlements of Ga-Nshonaa and Adedenpko. Similarly, a Climate Change Club was reported in Gbegbeyise (as shown in Plate 6.1). Moreover, the introductory explanations of climate change by data collectors may have assisted the respondents in contextualising their responses. Nevertheless, it was found during focus group meetings in the

study communities that, the residents had awareness about climate change, as they referred to this in their local language. These findings are contrary to the findings of similar studies conducted in informal settlements in developing countries (Roy & Sharma 2015; Wamsler et al. 2012). Roy and Sharma (2015) reported low levels of knowledge of climate change among residents of slums in Jamnagar (India). Also, the findings are contrary to the often suggested view that poor people tend to cause environmental pollution in cities, due to their low levels of knowledge about their environment, as suggested by Simon & Leck (2010).

Table 6.6: Perceived Linkage between Environmental Changes and Climate Change by the Age of Respondents

Settlement and perception of linkage between the two			Age range						Total
			18-25years	26-35years	36-45years	46-55years	56-60years	61+years	
Adedenkpo	Yes	N	15	38	28	24	23	16	144
		%	100	92.7	100	100	95.8	100	97.3
	No	N	0	3	0	0	1	0	4
		%	0.0	7.3	0.0	0.0	4.2	0.0	2.7
Ga-Nshonaa	Yes	N	21	80	26	8	1	0	136
		%	100	97.6	100	100	100	0	98.6
	No	N	0	2	0	0	0	0	2
		%	0.0	2.4	0.0	0.0	0.0	0	1.4
Gbegbeyise	Yes	N	2	62	43	24	11	2	144
		%	100	100	97.7	96.0	100	100	98.6
	No	N	0	0	1	1	0	0	2
		%	0.0	0.0	2.3	4.0	0.0	0.0	1.4
Old Fadama	Yes	N	2	86	33	15	10	0	146
		%	100	98.9	94.3	93.8	100	0	97.3
	No	N	0	1	2	1	0	0	4
		%	0.0	1.1	5.7	6.3	0.0	0	2.7

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

An important relation between city residents' knowledge about climate change with state officials', is the extent to which local knowledge is consistent with the knowledge of officials. The extent of this consistency, largely informs the nature of short-term or long-term planning they may adopt on climate change (Adger et al. 2013). In this current study, perspectives of state officials were elicited by posing a simple question of whether they perceived linkage between current environmental changes and climate change in Accra; all the institutional respondents answered in the affirmative. Interviewees included a representative from National Disaster Management Organisation (NADMO), the organisation responsible for disaster prevention and responses. In response, a senior staff of NADMO responded to the affirmative by noting that:

Of course, climate change and its impacts are with us. Hardly in the olden days do we get rains in a month like August, but these days, because of the change in climate, sometimes, it rains in August. But the peak of the rain should start from June, July. Moreover, do not be surprised that in some years, it delays, sometimes in June, the whole of June, we do not even have rains compared to 30 years back. We know that this drought – Harmattan– is from December and then January thereabouts; but this time it has changed. Drought or harmattan can happen in March, which should not be the case, compared to what we used to have (Interview #12).

The view of the interviewee from NADMO did match with that of senior staff of the second institution - Ministry of Environment, Science and Technology (MEST) - when he observed that:

The evidence abounds in terms of climate variability and change in terms of rainfall patterns, temperature or extreme weather occurrences and events clearly demonstrate that climate change and variability are with us. For example, we never had rains in August, as we presently do. The height of the rainfall too was in June, but these days we are not sure what it is as it sometimes does not even rain in June. Temperatures have risen both at night and during daytime (Interview #12).

Moreover, this reported view is consistent with that of an official of AMA who noted that: “...there is no doubt about a connection between the current events, rains, floods, temperature excesses and so forth we see, and climate change” (Interview #13). Similarly, a Sub-Metropolitan District Council staff in Accra City Authority noted that:

As we speak, climate change is affecting us and will do so in a much harder way to the people of Ga-Nshonaa, in particular. For instance, just recently, there were these tidal waves that flowed into the settlement to the extent that it took away outboard motors, fishing nets and a whole lot of properties over there. These waves have become more frequent and more devastating (Interview #15).

Overall, however, the majority perceptions which suggest a linkage between environmental changes and climate change can be understood as referring to both climate change and climate variability. Yet, a distinction between the knowledge of climate change and climate variability has ramifications for how city officials may plan to respond to a short-term variability of the climate or long-term changes of the same. Such distinction was aptly pointed to by a meteorologist of Ghana Meteorological Agency who noted that:

Very often, what the government staff refers to is climate variability, the short-term changes in weather conditions, that when they become long-term and reflect in changes in the mean averages of climatic variables, e.g. temperature, humidity and wind speed; then become climate change. According to the World Meteorological Organisation, for the climate of an area to have been considered changed, one requires proof of changes in the mean averages of climatic variables for at least 30 years. Given what we see

from our data of over 60 years, most of the current events in Accra are associated with climate change (Interview #17).

Climate variability is part of the processes of climate change, and a determination of their differences often requires systematic observation and analysis of climatic variables over at least 30 years (Allen et al. 2000). A similar finding was reported in a study conducted by Jabeen, Johnson and Allen (2010) in Korail, Dhaka (Bangladesh) and among residents of Mohammadpur (Jabeen & Johnson 2013). This finding supports the suggested view that adaptation scholars need to pay attention to the differences between the perception of climate variability and climate change. Doing so ensures that appropriate policy recommendations can be crafted from such studies towards improving informal settlements' residents' capacity to respond to climate change.

Plate 6.1: A Member of Climate Change Club in Gbegbeyise, Displaying Paraphernalia



Source: Photograph by author, July 2017

6.3.2 Perceived Causes of Climate Change

Perceptions and knowledge about the causes of global climate change are important in planning for improving households' capacity for responding to the impacts. It has been suggested that perceptions held by people do influence how they may accept responsibility for action on climate change (Okereke 2010). Moreover, people's perception of the cause of climate change largely determines how they may plan to respond to its impacts (Adger et al. 2006). To examine this knowledge, a question was posed to the study respondents on what they perceived as the

main causes of climate change. The responses were based on predetermined options gathered from literature review and fine-tuned through the pilot survey that was conducted in this study.

Survey results in Appendix 10 Table 7 show that at least 74 percent of the respondents in each study community perceived climate change as mainly caused by local level pollution activities. The local level activities include the burning of lorry tires and other forms of air pollution. This perception was consistent with the views expressed in focus groups meetings, as in Old Fadama where a member noted that:

We the community members are responsible for this climate change. People have been burning car tires all over the place, to heat water. This pollutes the air and causes climate change (Participant #2, Focus Group, Old Fadama).

The perception was more so among respondents in Gbegbeyise (84.2 percent) than in Adedenpko (76.4 percent), Ga-Nshonaa (74.6 percent) and Old Fadama (74.7 percent) (Appendix 10, Table 7).

Following this view was another that climate change is mainly an ‘Act of God’ (Appendix 10, Table 7). Up to 18.1 percent of the respondents from Ga-Nshonaa, compared to only 3.4 percent in Gbegbeyise reported this view. It is also interesting to note that both of these communities are original ethnic (‘Ga’) communities. Also, the view of climate change as an ‘Act of God’ appeared to be associated with the educational levels of the respondents. At least 83.3 percent of the respondents in each study community who supported this view was without formal education. This finding contrasts with a higher percentage (at least 80 percent) of respondents in each of the four study communities who linked climate change to global industrial activities and claimed to also have vocational or technical or tertiary level qualifications (Appendix 10 Table 7).

The finding that the respondents who associated climate change with the ‘Act of God’ also had lower educational levels could be associated with superstition in some of the study communities. For instance, a fetish shrine was found located within a proximate distance of Adedenpko and Ga-Nshonaa (in Jamestown, a native settlement). Again, it is interesting to note that this view was mainly expressed by elderly community leaders during focus group meetings as in Ga-Nshonaa when one noted that:

I do not agree with any of these reasons others have given here. These changes are caused by God because morality in society continues to decay. We have abandoned all our spiritual responsibilities as people, and expect things to remain the same way.

These are all punishments we have invited upon ourselves, which affect our fishing activities (Participant #2, Focus Group, Ga-Nshonaa).

The finding that many respondents perceived climate change as associated with the ‘Act of God’, while others associated it with local environmental polluting activities, was also reported in a study conducted in three other communities in Accra (Codjoe, Owusu & Burkett 2014). Furthermore, the opinion of the respondents suggests that residents of the study communities could be motivated to participate in climate mitigation planning. They may also willingly take initiatives to mitigate climate change impacts in their communities in Accra.

In contrast to the predominant view by the community members that climate change was linked to local anthropogenic activities, state officials interviewed generally associated climate change with the activities of industrialised countries. This view is exemplified by a comment from a Senior Officer in Ghana’s Environmental Protection Agency (EPA) who noted that:

Climate change is a global environmental change phenomenon. For instance, if you look at the contribution of carbon emissions, Africa as a whole contributes next to nothing to global climate change. But the impacts are not localised, so we all share in the costs of the emissions which is more from the developed world due to their higher use of fossil fuels. So we, the governments of developing countries, have always asked that they do more in the interests of climate justice (Interview #12).

Similarly, to an interviewee at Ghana’s Ministry of Environment Science and Technology, climate change is associated with global industrial activities as he said:

Indeed, climate change is a global environmental issue of concern. But the effects are local. The changes in rainfall patterns we see in Accra are obvious signs of climate change. We all know that it is increasing industrial activity in the developed countries that cause climate change, but we feel the brunt more such as increasing heat and floods. Those who create this problem have to do more to assist us in adapting to it (Interview #10).

Overall, the finding from the majority respondents who claimed to know about climate change and its potential causes is contrary to the often held view that environmental problems in cities are caused by the poor due to their lack of knowledge as by Glaeser (1998). This literature suggests that the survival needs of the urban poor often makes them overlook possible changes in their environments as that is of less priority to them. However, the responses from the state officials also support the commonly argued view that those responsible for climate change must be held to account more for it, supporting the discourse on climate justice in cities (Gunster 2017; Okereke 2010).

This notwithstanding, it was found that perceptions of the causes of flooding, as a potential climate change-related hazard, was framed within the politics of tenure insecurity and informal development in Accra. Two main and opposite views were expressed by the respondents in the study communities on the one hand, and among city officials interviewed on the other. The first view during focus group meetings with communities related to the conduct of government officials and city authorities. Community members blamed city authorities for not providing drainage infrastructure in informal communities. This view was expressed in Old Fadama as stated by this participant who said:

The refusal of AMA to provide drains in this community affects the flooding problem here. If they [Accra city authorities] continue to refuse to provide drains or even give us our peace of mind to do our own thing, how can we properly deal with the flooding problem in this community? (Participant #4, Focus Group, Old Fadama).

A study conducted by Douglas et al. (2008) also reported the same problem among residents of Alajo community in Accra. In this study, the respondents associated flooding with “*poor drainage, lack of consultation by officials and insensitivity to their problems*” (p.194).

The second view, which contrasts with the blame of city authorities by community members, was from city officials interviewed. To these officials, the flooding problem in Accra is rather partially caused by residents of informal settlements who build indiscriminately and dump waste in different locations in the city. This act of indiscriminate waste disposal obstructs the passage of water, thus exacerbating flooding in Accra as was expressed by an interviewee from the Physical Planning Department who said this:

The indiscriminate dwelling processes of Sodom and Gomorrah [Old Fadama] and other communities which are located along the Korle Lagoon have not only created problems for their inhabitants but also for the whole of Accra. They have obstructed the waterways with unauthorised structures, and dump their waste into the lagoon. They also keep fighting against their relocation and made it difficult for the government to complete the Korle Lagoon Ecological Restoration Project (Interview #13).

The findings of contested views about the causes of flooding among residents of the informal settlements and state officials in this study, are consistent with findings from other studies on informal settlements in Accra (Abeka 2014; Amoako 2015) and globally (Pelling 1997). For example, in noting the contested views among residents of informal settlements and city authorities in George Town (Guyana), Pelling (1997) observes that:

...‘bad citizens’ are blamed directly for dumping garbage and waste into the drainage canal,and for colonising seawall or canal reserves for informal housing. In this way, the structural problems underlying individual acts are overlooked and proximate

causes of vulnerability and risk too easily become the core concern of managerial discourse (p.259).

Overall, the results of this section show that the politics of tenure security and informal development may have influenced the framing of the flooding problem among the study respondents and city officials. This finding emphasises the importance of adaptation research to pay attention to power relations between local communities and state officials relative to the knowledge of climate change when developing early warning systems in urban areas.

6.4 Nature of Early Warning on Climate-related Hazards among the Respondents

The importance of access to early warning about disasters among urban dwellers has been emphasised in the disaster risks literature; access to early warning increases people's knowledge beyond their everyday knowledge of the climactic events they face (Bankoff & Hilhorst 2013). This section presents the study's findings on how the socio-economic and political contexts of the study respondents' may have influenced their access to early warning for responding to climate-related disasters.

6.4.1 Access to State Disaster-related Institutions and Early Warning on Hazards

By arrangement, the main institutions that are responsible for knowledge generation and early warning on climate change-related hazards in Accra are four. The first is Ghana Meteorological Agency (GMA), followed by National Disaster Management Organisation (NADMO), Ghana Fire Service (GFS), and District Assemblies (decentralised local governance authorities) (MEST 2010). Interviews conducted with relevant staff members revealed that the GMA generates information, which is shared with NADMO, whenever there is an adverse weather condition in the forecast. Also, the GMA directly engages in public weather service by informing the public about adverse weather conditions through radio and television stations. The Ghana National Fire Service, which is also responsible for education on prevention, as well as extinguishing fire outbreaks, does so directly in communities. Added to the three institutions are the local authorities which are responsible for coordinating with all other relevant agencies to directly provide early warning and disaster relief in communities (MEST 2010).

The study sought to know the extent to which the respondents were aware of, and found the work of key disaster management institutions as 'satisfactory' or 'not satisfactory'. Survey results show that at least 74.6 percent of the respondents in each community were aware of but

found the work of Ghana Fire Service as unsatisfactory. Moreover, this perception was differentiated among respondents in the various case study communities; it was highest (54.1 percent) in Adedenpko and lowest (44.2 percent) in Ga-Nshonaa, although the communities differed in terms of their tenure security statuses. Ga-Nshonaa is a squatter settlement while Adedenpko has recognised tenure security by the local authorities. Put together, these perceptions, however, contrasted with the view of a staff at Ghana Meteorological Agency when he claimed that: “*we use agencies and groups, FM station and television stations and so forth, to inform the public about the weather, as promptly as we can*” (Interview #17).

It was also found that the respondents’ perceptions on the performance of Ghana Fire Service were similar to those related to NADMO, as shown in Table 6.7. Survey results show that at least 74.6 percent of the respondents in each community were aware of, but found the work of Ghana Fire Service as unsatisfactory. This perception differed in terms of community, with the highest percentage of responses in Gbegbeyise (82.2 percent), and the lowest in Ga-Nshonaa (74.6 percent). Moreover, the lowest percentage of those who claimed to be unaware of Ghana Fire Service was in Gbegbeyise (13.7 percent), compared to 21.7 percent in Ga-Nshonaa. This finding suggests that the level of awareness and satisfaction among the respondents, per se, was not associated with their tenure security status. In addition, the results show that most respondents were aware of the Ghana Meteorological Agency but found its performance as unsatisfactory (at least 52 percent in each community). However, relatively lower percentage of respondents (at least 12.9 percent) in each of the study communities found the work of Ghana Meteorological Agency as satisfactory while much lower percentage (at least 18.9 percent in each community) reported being unaware of the same. Thus, more than half of the respondents in all the four study communities held the perceptions that the performance of state-disaster management institutions was unsatisfactory or were unaware of the presence of such institutions in their community.

Table 6.7: Perceived Presence and Performance of State Disaster Management Institutions in the Study Settlements

Settlement and presence of disaster-related institutions		National Disaster Management Organisation			Ghana Fire Service Department			Ghana Meteorological Agency		
		Aware of and satisfactory	Aware of and unsatisfactory	Not aware	Aware of and satisfactory	Aware of and unsatisfactory	Not aware	Aware of and satisfactory	Aware of and unsatisfactory	Not aware
Adedenkpo	N	10	80	58	15	112	21	37	78	33
	%	6.8	54.1	39.2	10.1	75.7	14.2	25.0	52.7	22.3
Ga-Nshonaa	N	21	61	56	5	103	30	52	70	16
	%	15.2	44.2	40.6	3.6	74.6	21.7	37.7	50.7	11.6
Gbegbeyise	N	29	71	46	6	120	20	32	85	29
	%	19.9	48.6	31.5	4.1	82.2	13.7	21.9	58.2	19.9
Old Fadama	N	21	70	59	2	122	26	34	84	32
	%	14.0	46.7	39.3	1.3	81.3	17.3	22.7	56.0	21.3

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

Nevertheless, while most respondents in Adedenkpo (87.1 percent) and Old Fadama (82.7 percent) reported having received an early warning from external sources over the past one to two years, the percentage was relatively lower in Gbegbeyise (76 percent) and much lower in Ga-Nshonaa (11.6 percent) (Table 6.8). External sources of early warning included television broadcast, radio broadcast, government officials or community-based group.

In terms of gender, slightly more female respondents than male respondents in Adedenkpo reported having received early warning information from external sources in the period. This contrasts with slightly more male respondents than female respondents in Gbegbeyise and Old Fadama who reported doing the same. This finding suggests that access to early warning information was gendered in the study communities, contrary to findings from other studies conducted in similar contexts. For example, Bob and Jaggernath (2014), claimed in their study in northern Nigeria that, women had less access to early warning information than men. The scholars suggested this was so due their extra burden as managers of their homes making women comparatively less able to contact external agents.

Table 6.8: Percentage of Male and Female Respondents Who Received Early Warning from External Sources over the last 1 to 2 years in the Study Settlements

Settlement and reception of early warning over the last 1 to 2 years			Gender		Total
			Male	Female	
Adedenkpo	Yes	N	100	20	120
		%	80.0	87.0	81.1
	No	N	25	3	28
		%	20.0	13.0	18.9
	Total	N	125	23	148
		%	100.0	100.0	100.0
Ga-Nshonaa	Yes	N	16	0	16
		%	12.4	0.0	11.6
	No	N	113	9	122
		%	87.6	100.0	88.4
	Total	N	129	9	138
		%	100.0	100.0	100.0
Gbegbeyise	Yes	N	96	15	111
		%	76.8	71.4	76.0
	No	N	29	6	35
		%	23.2	28.6	24.0
	Total	N	125	21	146
		%	100.0	100.0	100.0
Old Fadama	Yes	N	110	14	124
		%	84.6	70.0	82.7
	No	N	20	6	26
		%	15.4	30.0	17.3
	Total	N	130	20	150
		%	100.0	100.0	100.0

Source: Author's construct, based on the household survey

The study respondents also mainly consulted a variety of sources of early warning over the last one to two years, including radio, television, 'relatives and friends', and the related government officials (Appendix 10 Table 8). Survey results were, however, spatially differentiated; most respondents (41.2 percent) in Adedenkpo claimed to have mainly received an early warning from a radio broadcast, while most respondents (88.4 percent) in Ga-Nshonaa mainly received the same from 'relatives and friends'. This contrasts with most respondents in Gbegbeyise (58.9 percent) and Old Fadama (44.0 percent) who reported to have mainly received an early warning through television broadcast, as shown in Appendix 10 Table 8.

The results also differed according to the gender of the respondents; a relatively higher proportion of male respondents than female respondents claimed to have mainly received an early warning through "friends and relatives" in all the four study communities. The socio-economic characteristics and nature of amenities that are available in the study settlements may have influenced this pattern of sources of early warning for the respondents in this study. It is

logical to conclude that, since most (88.9 percent) respondents of Ga-Nshonaa were found without electricity connection in their dwellings, they were unable to use television sets. However, the dominance of radio and television as sources of early warning in the three other communities may also be understood by the fact that most radio stations and few television stations in Ghana use local dialects to broadcast their messages (Alhassan 2005). This allows residents who have access to both television and radio sets for consultation on sources for early warning on disasters.

Overall, the variety of sources of early warning reported in this study were similar to those reported from a study conducted by Warmsler and Brink (2014) in Latin America and Asia. In this study, Warmsler and Brink (2014) reported that unequal access to information on disasters between residents of informal settlements and more formalised settlements had enabled the latter to better respond to disasters. This finding underscores the importance of the differentiated socio-economic characteristics of urban dwellers in the development of early warning systems.

Also, the relative significance of community-based organisations as a source of climate change-related knowledge may have been influenced by the nature of access to early warning information from the state disaster management institutions. For example, an early warning system has been set-up for fisher folks in Ga-Nshonaa by state institutions, given the community's function as the hub for artisanal fishing activities in Accra (see Plate 6.2 and Plate 6.3). However, it was found that the city authorities also regularly threatened the residents of Ga-Nshonaa with forced eviction potentially influencing their ability to respond to climate change, as discussed earlier in Chapter Five.

Plate 6.2: Ocean Weather Monitoring Board in Ga-Nshonaa



Source: Photograph by author, July 2017

Plate 6.3: Flagging for Dangerous Ocean Conditions in Ga-Nshonaa



Source: Photograph by author, July 2017

Moreover, it was found that the legal status of the residents of informal settlements may also have influenced the nature and quality of early warning they received from the state institutions.

For instance, the legal status of informal settlements was linked with the siting/location of weather monitoring equipment by the GMA, when the interviewee said that:

Unfortunately, we do not deploy monitoring equipment in places like Old Fadama, given their challenges with state agencies. They, like other squatters, are located in hazardous places, and our equipment could be easily damaged (Interview #17).

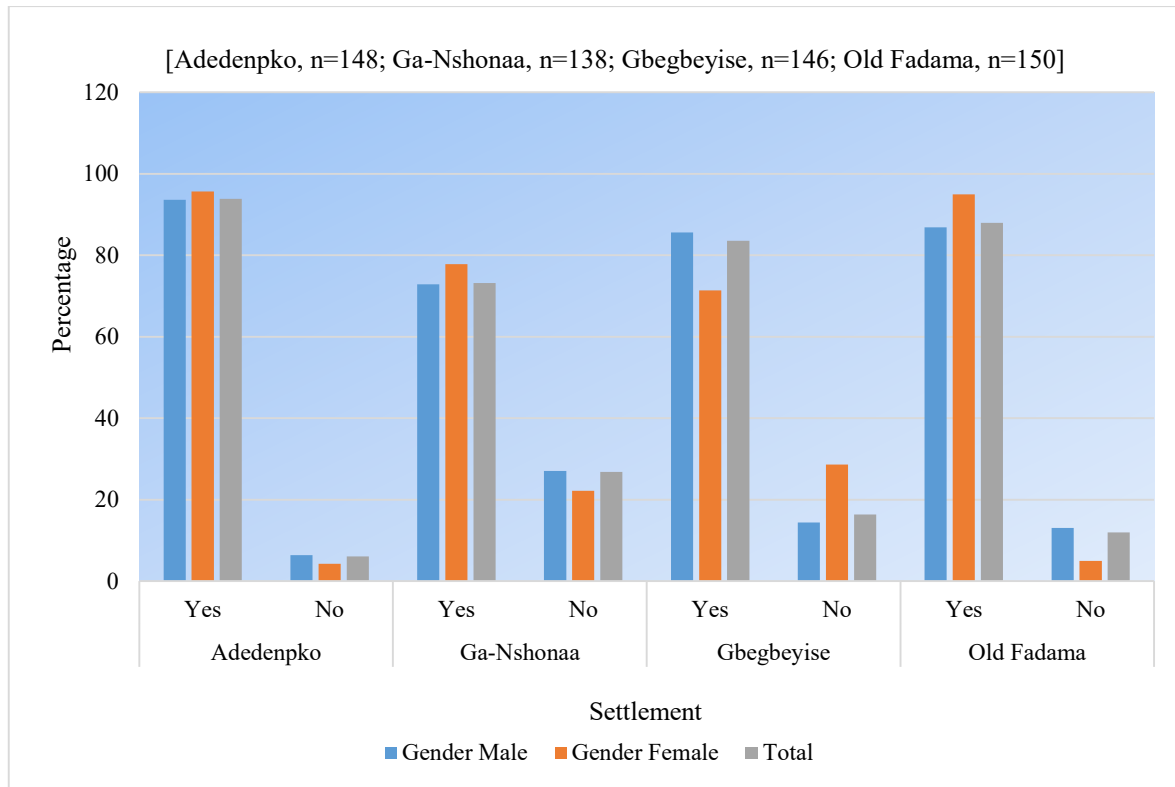
A similar finding was reported by Amoako (2014) in his study in Accra, which suggests a pattern of the relationship between the Ghana Meteorological Agency and residents of informal settlements. By not locating/siting weather monitoring equipment in informal settlements, localised weather information from these communities is often not generated. This may have influenced the nature of the perceptions reported by most respondents to the effect that, state disaster management institutions are performing sub-optimally. Moreover, this finding may have influenced the consultation of local knowledge sources by some respondents in the study settlements.

As has been argued by Orlove et al. (2010), local knowledge can make a valuable contribution in gaining a better insight into climate change in places where formal early warning systems are weak. The study then asked respondents if they were aware of, and often resorted to any local knowledge on climate change in their daily lives. Findings of the survey in Figure 6.4 show that at least 73.2 percent of the respondents in each study community reported applying informal sources of knowledge of climate change. This was more so among female than male respondents in all the study communities, except for Gbegbeyise as show in Figure 6.4. This finding was also spatially differentiated; it was highest in Adedenpko (93.9 percent) and lowest (73.2 percent) in Ga-Nshonaa. In terms of the gender of the respondents, only marginal differences were noticeable, with more female respondents than male respondents, in all three of the four case study communities except Gbegbeyise reporting this practice (Figure 6.4). Moreover, although no clear reason explains this finding, it seems the longevity of the stay of the residents in the various communities may have partly accounted for this finding. Residents of Adedenpko who are mainly ethnic 'Ga' have been longer in their community than in the case of Ga-Nshonaa, a relatively younger squatter settlement.

Findings from focus group meetings provided further details of the nature and variety of informal weather monitoring arrangements that are applied in the case study communities. They were found to be based on observation of life patterns of living organisms (animals and

plants), reading of atmospheric and extra-terrestrial bodies, as well as daily observation of the conditions in the oceans (presented in Table 6.10).

Figure 6.5: Awareness and Application of Informal Knowledge according to Gender of Respondents in the Study Settlements



Source: Author's construct, based on the household survey

Plate 6.4: Mounted Loud Speaker to Facilitate Knowledge Dissemination in Gbegbeyise



Source: Photograph by author, July 2017

Table 6.9: Examples of Informal Monitoring Methods on Climate in the Study Settlements

- Sighting of cowbirds to signify impending rains
- Movement of winds northwards of Accra with thunder signifies impending rains
- Dead whales swept onto the shores show conducive sea temperatures and a bumper harvest of fish shortly
- Different colours of the moon (brownish or greyish) sighted at dawn signifies intensive rains in the day
- Sighting a vulture incubating in June shows an impending drought or limited rainfall will be more prolonged
- The appearance of a rainbow indicates that rains will not fall immediately.
- Very dark coloured and moving clouds sighted moving from east to west, when accompanied by winds, indicate heavy rainfall within hours.

Source: Synthesised from focus group discussions in the study communities

As displayed in Table 6.9, the sighting of cowbirds was reported to signify impending good rains. Other measures such as the ‘croaking’ of frogs, or siting of ants carrying food into their holes, indicate an imminent rainfall. Also, the sighting of movement of winds north-westwards, when associated with thunder and lightning in June/July, was said to indicate the occurrence of heavy rains within a time frame of about an hour. Furthermore, the sighting of dead whales swept to the shoreline was reported to be associated with good rains and plentiful harvests of fish within a few months.

Overall, findings of methods adopted for monitoring weather through an examination of celestial bodies, plants, and animals in this study, are similar to findings from other studies conducted in similar contexts (Codjoe, Owusu & Burkett 2014; Orlove et al. 2010). Codjoe, Owusu and Burkett (2014) report from their study in three other underprivileged communities that, this variety of modes of monitoring weather were also related to the cultural practices of the residents. Together, the findings further support the importance for adaptation scholars to pay attention to the relationship between the different socio-cultural characteristics of urban dwellers and their access to early warning systems on disasters.

6.5 Conclusion

This chapter has examined the perceptions and knowledge of climate change among residents of four informal settlements and related state officials in Accra. It reveals four main findings. Firstly, respondents mainly perceived changes in climate change related-phenomena of temperature rise, rainfall patterns, coastal erosion, sea-level rise, floods, storms, and saltwater intrusion in their communities. These perceptions were found to have been in synergy with scientific sources that showed changes in temperature, sea levels, storms and rainfall patterns in Accra. However, the respondents' claims of increases flooding, were not supported by scientific studies and or data on Accra. Nevertheless, there was concordance between the majority of respondents' views about the timing of the occurrence of rainfall, excessive heat, storms, and flooding, and that of scientific sources on the same variables in Accra.

Secondly, there were different influences of some socio-demographic characteristics of the respondents on their knowledge of climate change. Specifically, while the literacy level of the respondents was unrelated to their perception about environmental changes and climate change, their educational levels were associated with their perceptions about the causes of climate change. Most respondents perceived climate change as caused by local activities, while fewer associated climate change with the 'act of God'. This pattern of perceptions was found to be associated with the respondents' educational levels; those without formal educational qualifications perceived climate change as mainly the 'act of God', while those with higher levels of education perceived it as mainly caused by various local and global anthropogenic activities. However, community members and city authorities disagreed on the causes of flooding as a climate change-related hazard. Specifically, while state officials blamed residents for building their dwellings illegally and blocking access to flood water, the residents, in turn,

blamed the city authorities for not providing drainage infrastructure to facilitate the flow of floodwater in their communities.

Finally, the socio-political context of the respondents had a relation with their access to an early warning on climate change-related hazards. Specifically, the majority of the respondents perceived state disaster management institutions as not performing optimally in the study communities. Moreover, by the nature of land ownership in informal settlements, the Ghana Meteorological Agency does not site weather monitoring equipment in informal settlements. Therefore, the respondents' socio-economic and political contexts have differentiated relationship with their knowledge and capacity to respond to climate change. Nevertheless, individuals' perceptions and knowledge of hazards notably influence their capacity and decision-making to respond to the same (Renn et al. 1992). The influence of the study respondents' perceptions and knowledge on their adaptive responses to climate change-related vulnerabilities are presented in the next chapter.

7 CHAPTER SEVEN: ADAPTIVE RESPONSES TO SOCIAL AND CLIMATE CHANGE-RELATED VULNERABILITIES

7.1 Introduction

This chapter examines the responses that were adopted by the study respondents to climate change-related hazards and their contextual social vulnerabilities. It provides an answer to the third main thesis question of “Who adapts to what and why in the context of climate change-related hazards and social vulnerabilities in informal settlements in Accra?” Three embedded questions answered in this chapter are 1) what responses are adopted to minimise socio-economic contextual vulnerabilities, and how do they relate to climate change in informal settlements? 2) how do socio-economic characteristics of residents of informal settlements relate to their adaptation options to climate change-related hazards in their built environments? and 3) what funding and/or support mechanisms are available for minimising social contextual and climate change-related vulnerabilities in informal settlements?

It should be noted that answers to these questions relate to the respondents’ vulnerabilities as were found and discussed in Chapter Five. Also, the respondents’ knowledge of climate change influences their capacity to respond to the same, as discussed in Chapter Six. The chapter is based on findings from the household surveys and elaborated on with data from focus group discussions in the study settlements. To further explain the survey results, results from interviews conducted with staff of relevant institutions are also integrated with the survey findings in parts of this chapter.

This chapter shows four main findings. Firstly, the respondents, as active agents, do adopt economic measures to minimise their economic vulnerabilities, including transforming climate-related hazards into positive effects. However, this was not associated with the nature of their land ownership. Secondly, the respondents mainly adopt structural responses to climate change-related hazards in their built environment, which were associated with the nature of their land ownership arrangements. Thirdly, in addition to households responses which are mainly funded through household resources, communal responses are taken through mobilisation and collective action to climate change-related vulnerabilities in the study settlements. Fourthly, while institutional responses have been limited to only two settlements

who mainly own their land, these measures have been limited to distribution of relief items after hazards.

The rest of the chapter has been structured into four sections. It first examines the study respondents' economic responses to their contextual socio-economic vulnerabilities and in relation to climate change and variability. This is followed by a presentation of their adaptive responses to three main climate change-related hazards: flooding, temperature rise/excessive heat, and storms that commonly impact on their built environments. Following these is a discussion of the funding and/or support networks, including institutional and collective responses to climate change-related and social contextual vulnerabilities in the study communities. The final section then synthesises the adaptive responses by the study respondents to multiple climate change-related hazards, as influenced by their socio-economic, political and institutional contexts and capacity to respond.

7.2 Economic-related Responses and Climate-Related Vulnerabilities

As noted by Long (2003), individuals such as heads of households in informal settlements, are not 'passive and helpless victims' of external socio-economic interventions or climatic hazards. Urban dwellers as active agents and managers of their vulnerabilities, often adopt 'non-hazard specific' responses to minimise their socio-economic vulnerabilities, helping them to be less affected by climate change (Blaikie et al. 2014; Bulkeley 2013). In this section, findings on measures that were adopted by the respondents to minimise based on the prevalent capacity to respond to their socio-economic and climate change-related vulnerabilities are presented.

7.2.1 Changing Economic Activities to Minimise Contextual Vulnerability

Two main economic-related adaptive responses were reported by the respondents in this study. As shown in Table 7.1, when discussing the major economic adaptive response, respondents in this study reported changing economic activities over the last one to five years as their main strategy. In addition, respondents discussed the transformation of climatic hazards as a strategy to minimise their socio-economic related vulnerabilities, as discussed in section 7.2 of this chapter. To examine the respondents' potential changes in their economic activities (adaptive economic responses), they were asked to state their main economic activities both at present and 'one to five' years ago.

As shown in Table 7.1, at least 83 percent of the respondents in each study community were employed in various informal sector activities, including commerce, portage and electronic/metal waste recovery. Compared to all the other informal economic activities, the highest percentage of the respondents were engaged in trading/commerce in Adedenpko (56.1 percent), Old Fadama (49.3 percent) and Gbegbeyise (34.9 percent) (Table 7.1). This was different in the case of Ga-Nshonaa, where the highest proportion (42 percent) was engaged in fishing, inclusive of the processing and sale of fish (Table 7.1). The location of Old Fadama near arguably the largest ‘open market’ in Accra, may have accounted for the dominance of trading and significance of portage (head portage and pushed-cart portage) in this community. This finding has also been reported by Afenah (2009b) in her study in Accra.

However, artisanship (masonry, block laying and metal fabrication), was also found as the economic activity for less than five percent of respondents in each of the study communities. Up to 4.1 percent, 5.1 percent, 2.7 percent and 1.3 percent in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama, respectively reported this. This was similar to those found engaged in portage and ‘electronic and metal waste recovery’ in three of the four study communities, excluding Gbegbeyise. Added to the categories of people employed were less than six (6) percent of respondents in each study community engaged in each of food vending, agriculture, carpentry and other artisanship for a living, as shown in Table 7.1. However, less than 5.5 percent of the respondents in each of the case study communities reported themselves as unemployed (Table 7.1). Those who reported as unemployed, have had to depend on relatives near and far of their communities, friends as well as on previously accumulated assets, among other sources.

Table 7.1: Respondents' Changes in Main Economic Activities by Study Settlement

Economic activities/status		Settlement (as at 2017)				Settlement (1 to 5 years prior to 2017)				Changes in proportions over the different periods in each community			
		Adedenkpo	Ga-Nshonaa	Gbegbeyise	Old Fadama	Adedenkpo	Ga-Nshonaa	Gbegbeyise	Old Fadama	Adedenkpo	Ga-Nshonaa	Gbegbeyise	Old Fadama
Fishing (including fish mongering)	N	5	58	29	0	5	67	38	0	0	-9	-9	0
	%	3.4	42	19.9	0	3.4	48.6	26	0	0	-6.6	-6.1	0
Food Vending	N	3	4	19	9	3	4	19	9	0	0	0	0
	%	2	2.9	13	6	2	2.9	13	6	0	0	0	0
Trading	N	83	38	51	74	75	34	46	74	8	4	5	0
	%	56.1	27.5	34.9	49.3	50.7	24.6	31.5	49.3	5.4	2.9	3.4	0
Agriculture	N	1	0	2	0	1	0	2	0	0	0	0	0
	%	0.7	0	1.4	0	0.7	0	1.4	0	0	0	0	0
Carpentry	N	3	6	5	5	3	6	5	5	0	0	0	0
	%	2	4.3	3.4	3.3	2	4.3	3.4	3.3	0	0	0	0
Processing/ Manufacturing	N	0	2	6	6	0	2	6	6	0	0	0	0
	%	0	1.4	4.1	4	0	1.4	4.1	4	0	0	0	0
Other Artisan	N	6	7	4	2	6	7	4	2	0	0	0	0
	%	4.1	5.1	2.7	1.3	4.1	5.1	2.7	1.3	0	0	0	0
Other Services	N	1	2	15	5	10	1	11	8	-9	1	4	-3
	%	0.7	1.4	10.3	3.3	6.8	0.7	7.5	5.3	-6.1	0.7	2.8	-2
E-waste/metal recovery	N	10	5	0	18	10	3	0	15	0	2	0	3
	%	6.8	3.6	0	12	6.8	2.2	0	10	0	1.4	0	2
Portage(head portage and push-cart)	N	11	9	0	18	10	8	0	18	1	1	0	0
	%	7.4	6.5	0	12	6.8	5.8	0	12	0.6	0.7	0	0
Unemployed	N	8	5	7	6	8	5	7	6	0	0	0	0
	%	5.4	3.6	4.8	4	5.4	3.6	4.8	4	0	0	0	0
Other	N	17	2	8	7	17	1	8	7	0	1	0	0
	%	11.5	1.4	5.5	4.7	11.5	0.7	5.5	4.7	0	0.7	0	0

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

It was also found that some respondents' dependence on some economic activities about a year to five years ago, had changed when compared to the present (2017) (Table 7.1). For instance, the survey results show a reduction by about six (6) percent for those engaged in fishing and fish mongering in each of the shoreline communities over the two periods; Ga-Nshonaa (6.6 percent) and Gbegbeyise (6.1 percent) as depicted in Table 7.1. This was similar to a reduction in those who reported having hitherto engaged in 'other services' in Adedenkpo and Old Fadama. This finding, however, contrasts with those respondents in Ga-Nshonaa and

Gbegbeyise, who hitherto engaged in ‘other services’ over the two different periods (in 2017 and 1-5 years before 2017) in the four study settlements (Table 7.1). In contrast to the decline in respondents’ dependence on fishing, Table 7.1 shows that those who hitherto engaged in trading, ‘electronic waste/metal recovery’ as well as portage, had marginally increased over the two periods in all the study settlements. Nevertheless, the respondents who reported as unemployed over the same period remained the same, similar those who were engaged in other activities such as food vending, agriculture, and carpentry in each study settlement, as shown in Table 7.1.

Overall, the trends in Table 7.1 suggest a dominant informal sector as a source of permanent economic livelihood for the residents of informal settlements in Accra, as has been reported from other studies (Anyidoho & Steel 2016; GSS 2014; Jabeen, Johnson & Allen 2010). A study conducted by Ghana’s Statistical Services found that most (71 percent) of the employed population in Accra earned their livelihoods from the informal sector (GSS 2014). This finding can be understood in the context of the historic political and economic events, including the economic reforms that took place in Ghana, as discussed earlier in Chapter Two.

Moreover, the reported significance of trading as a sector for economic adaptation could be viewed in two ways. First is the reported perceived ease of entry to trading as a source of economic livelihood as was widely discussed in focus group meetings. This is exemplified by a member in Old Fadama who noted that:

As for buying and selling, all you need is some small money to buy a few items to start. You do not need much land or space too, anywhere you can get to sit people will buy. That is why most of us here buy and sell (Participant # 5, Traders Focus Group, Old Fadama).

The second reported reason for the choice of trading as an economic response strategy was the perception that trading is a higher earning activity when compared to other economic activities. This view was also expressed in focus group meetings, exemplified by a female participant in Old Fadama, who observed that: *“I presently earn over two times what I used to earn when I was selling food, now that I buy and sell [goods]”* (Participant # 5, Focus Group for Traders, Old Fadama). However, traders also voiced out their concerns about the absence of good market centres which could make them less prone to climate-related events such as flooding and periodic heatwaves. This was also observed during field data collection, as traders often adopted several coping measures such as positioning themselves under sheds during rains or

wearing heavy huts during excessive heat during their trading activities (shown in Plate 7.1 and Plate 7.2).

In contrast to the dominance of trading, the decline in fishing and fish mongering as an economic sector was associated with both the economic policy environment and climate change. Many residents of the shoreline communities during focus group meetings shared this view, as shown by a resident of Ga-Nshonaa who noted that:

I was previously engaged in more fishing and less of this 'buying and selling' [of goods/wares], but later realised that it was better to focus more on 'buying and selling' than spend more time on fishing. This is because the amount of fish available in the sea here has reduced so much with the changes in the seasons. And these big foreign fishing companies too, which have been catching all the different sizes of fish have reduced the fish that was available to us (Participant #2, Trade Focus Group, Ga-Nshonaa).

This reported effect of trade liberalisation in Ghana, such as competition posed by the foreign fishing fleet to artisanal fisher folks, in the shoreline communities, has also been reported by other studies in Accra (Atta-Mills, Alder & Rashid Sumaila 2004; Nunoo et al. 2014). For example, Atta-Mills, Alder and Rashid Sumaila (2004) reported two main findings from their study. They found that the volume of fish caught by artisanal fisher folks had been reducing due to their inability to compete with the foreign industrial fishing boats. The second finding was that artisanal fisher folks often engaged in conflicts with fishing trawlers due to disagreements over their zones of operation, which affected the letters' ability to work efficiently. Overall, the influence of the economic policy on the respondents in this study can be understood within the institutional context of the theoretical framework of this thesis. Institutions as the rules, norms, regulations and policies which govern access to resources, do influence households' and communities' responses to their contextual vulnerabilities and climate-related hazards (Ostrom 2010).

Plate 7.1: A trader under Shed during Rains in Ga-Nshonaa



Source: Photograph by author, July 2017

Plate 7.2: Traders covering up from the Sun in the Central Business District of Accra



Source: Photograph by author, July 2017

Economic responses adopted for minimising socio-economic vulnerabilities in this study are similar to those reported from other studies conducted in informal settlements in Asia (Jabeen, Johnson & Allen 2010; Wamsler & Brink 2014) and Latin America (Wamsler & Brink 2014). In their study of adaptive practices among residents of slums in Medellin (Colombia), Wamsler and Brink (2014) found that the residents often changed their livelihood activities to help them in better accumulating financial resources. This was also reported by Jabeen, Johnson and Allen (2010) from their study in Korail, Dhaka (Bangladesh), where residents diversified their economic activities, accumulated assets, procured the needed housing maintenance materials, as well as increased their food stocks. Doing so assisted the residents in building their capacities for responding to future climate change-related hazards.

7.2.2 Adopting Multiple Economic Activities and Transforming Climatic Hazards

In addition to changes in economic activities, over eight (8) percent of the respondents in each study settlement reported to often adopt multiple livelihood activities (minor activity) to minimise their socio-economic vulnerabilities (Table 7.2). There were marked differences between respondents who adopted multiple livelihood activities across the different study settlements; less than 15 percent in each of the three other study communities, compared to about a quarter in Adedenpko (24.3 percent) reported doing so. In terms of gender, more male respondents (28 percent) than female respondents (4.3 percent) in Adedenpko reported so. This, however, contrasts with more female respondents than the male respondents in each of Ga-Nshonaa (11.1 percent compared to 7.8 percent), Gbegbeyise (23.8 percent compared to 12 percent), and Old Fadama (15 percent compared to 14.6 percent) who were engaged in this practice (Table 7.2). Nevertheless, no marked differences were noticeable among renters and landlords who engaged in this practice in Adedenpko (23.9 percent compared to 25 percent), and Gbegbeyise (16.9 percent compared to 11.1 percent). Moreover, it is shown in Table 7.2 that the differences were, marked in Old Fadama, where more than twice as many landlords as tenants (17.5 percent compared to 5.6 percent) reported engaging in multiple livelihood activities.

In addition to the differences associated with the gender and tenancy statuses of the respondents, the size of their households was also found to have potentially influenced their choice for multiple livelihood activities. It is shown in Table 7.2 that larger household sizes were more engaged in multiple livelihood activities than smaller household sizes. Increased

economic demands on larger household sizes which require them to engage in additional means of income generation, may have influenced this adaptive strategy, as was reported among residents in other informal settlements in Latin America (Wamsler & Brink 2014). However, the finding that keeping multiple livelihood activities was not associated with a household's ownership of property (whether a landlord or tenant household), is contrary to the often suggested relationship, such as by Roy, Hulme and Jahan (2013). Roy, Hulme and Jahan (2013), found from their study that relatively more landlord-households than renter-households in Magbara and Supraghat settlements in Dhaka (Bangladesh), were engaged in multiple livelihood activities. The reason adduced was their relative superior property rights in their communities.

Table 7.2: Respondents who have Another Livelihood According to Gender, Tenancy, and Household size in the Study Settlements

Settlement/ community			Gender		Residential tenancy status		Household size (recategorised)			Total
			Male	Female	Landlord	Renter/ tenants	Less than 5 members	5-8 members	Above 8 members	
Adedenkpo	Yes	N	35	1	22	14	30	6	0	36
		%	28	4.3	23.9	25	21.4	75	0	24.3
	No	N	90	22	70	42	110	2	0	112
		%	72	95.7	76.1	75	78.6	25	0	75.7
Ga-Nshonaa	Yes	N	10	1	11	0	9	2	0	11
		%	7.8	11.1	8	0	6.7	66.7	0	8.0
	No	N	119	8	127	0	126	1	0	127
		%	92.2	88.9	92	0	93.3	33.3	0	92.0
Gbegbeyise	Yes	N	15	5	11	9	13	6	1	20
		%	12	23.8	16.9	11.1	10	40	100	13.7
	No	N	110	16	54	72	117	9	0	126
		%	88	76.2	83.1	88.9	90	60	0	86.3
Old Fadama	Yes	N	19	3	20	2	19	3	0	22
		%	14.6	15	17.5	5.6	13	75	0	14.7
	No	N	111	17	94	34	127	1	0	128
		%	85.4	85	82.5	94.4	87	25	0	85.3

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

Climate-related hazards can affect the abilities of households in urban areas to sustain their livelihoods (Cutter et al. 2008). However, studies have suggested that households and communities, also sometimes transform or develop adaptive solutions to minimise their vulnerability to future hazards (Adger, Kelly & Ninh 2012; Revi et al. 2014). This study, therefore, sought to examine the potential relations between respondents' choice of multiple economic activities and climate change/variability in their communities. The survey results

show that a total of 36 percent of respondents in Adedenkpo, 36.4 percent in Ga-Nshonaa, 20 percent in Gbegbeyise and 31.8 percent in Old Fadama claimed their alternative livelihoods were related to climate change/variability.

There were, however, a few noticeable differences among the male-lead and female-lead, as well as tenant or landlord households' adaptive responses. More female compared to male respondents in three of the four study communities, except Gbegbeyise reported transforming climatic hazards to useful economic opportunities (Table 7.3). Furthermore, more landlords than tenants, in the communities except Gbegbeyise reported transforming climatic hazards to positive economic opportunities.

Table 7.3: Respondents Whose' Choice of Alternative Livelihoods Involved Transforming Climate-related Hazards by Gender and Tenancy Statuses

Settlement/community			Gender		Residential tenancy		Total
			Male	Female	Landlord	Renter/tenants	
Adedenkpo	Yes	N	12	1	8	5	13
		%	34.3	100.0	36.4	35.7	36.1
	No	N	23	0	14	9	23
		%	65.7	0.0	63.6	64.3	63.9
	Total	N	35	1	22	14	36
		%	97.2	2.8	61.1	38.9	100.0
Ga-Nshonaa	Yes	N	4	0	4	0.0	4
		%	40.0	0.0	36.4	0.0	36.4
	No	N	6	1	7	0.0	7
		%	60.0	100.0	63.6	0.0	63.6
	Total	N	10	1	11	0.0	11
		%	90.9	9.1	100.0	0.0	100.0
Gbegbeyise	Yes	N	2	2	1	3	4
		%	13.3	40.0	9.1	33.3	20.0
	No	N	13	3	10	6	16
		%	86.7	60.0	90.9	66.7	80.0
	Total	N	15	5	11	9	20
		%	75.0	25.0	55.0	45.0	100.0
Old Fadama	Yes	N	6	1	6	1	7
		%	27.3	4.5	27.3	4.5	31.8
	No	N	13	2	14	1	15
		%	68.4	66.7	70.0	50.0	68.2
	Total	N	19	3	20	2	22
		%	86.4	13.6	90.9	9.1	100.0

Source: Author's construct, based on the household survey

Plate 7.3: Privately Owned and Operated Source of Water for Sale in Old Fadama



Source: Photograph by author, July 2017

Findings from focus group meetings conducted in all the four study settlements provided details on the diversity of adaptive economic responses of the study participants. It was found that the capacity to transform climate change-related phenomena into economic opportunities was varied and often associated with the respondents' knowledge of the same. This is exemplified by the view expressed by a community member in Adedenpko who said that:

As for me, the heat is useful to my work. I make trunks from metal sheets for sale, and I need the heat from the sun to dry these trunks after painting them. My knowledge of the weather changes and heat in this community has been very helpful to my work (Participant #2, Focus Group for Crafts, Adedenpko).

Adaptive responses which involved the transformation of climatic hazards also include taking advantage of storms, as well as saltwater intrusion to engage in economic activities in the study communities. An example of the transformation of storms was mentioned by a discussant/participant in a focus group meeting in Gbegbeyise who noted that:

Although we do not pray for storms to occur, when they do, we are the ones they call to fix the removed roofs. So we also benefit from them [storms] (Participant #2, Focus Group for Crafts, Gbegbeyise).

Other residents of the study communities reported engaging in supplying water for sale in response to groundwater salinity in their communities (Plate 7.2). This practice was referred to by the residents who have access to land, as exemplified by a private water vendor in Old Fadama who said that:

I am connected to the Ghana Water Company line. I pay over GH¢1000 a month for my water. If you look at how much it costs me to lay a pipeline from the outskirts of the community into my house, there is much money involved. Then I have to put up my structure, the bathhouse, employ someone to clean it, wash it every day, buy fuel to boil the water to sell. When I burst my pipeline, Ghana Water Company will not come here to mend it. I will dig it out and mend it myself. I also need to channel away from the wastewater from the community; so I lay pipes from my house to the lagoon. This makes the cost of water go up because as a business person, I need to make a profit. Boiled water costs 1 Ghana cedis and the cold one cost 60 pesewas. We know this is on the high side because when you go to the other areas in the city, it costs only 30 pesewas for the same gallon of water. But because of our difficulties in setting up our business and paying a flat fee to GWCL, we are forced to sell at that price (Community Leader and Water Vendor, Focus Group, Old Fadama).

The finding that residents of the study communities bought expensive water from other community members can be understood in the context of the role of informality and the cost of urban service delivery. Mitlin and Satterthwaite (2013) in their study found that, while formalisation of water connection tends to reduce its cost to urban dwellers, the constraints in informality adversely influence its availability and high price in such settlements.

Overall, the variety of activities reported from the study settlements involving the transformation of climatic hazards, are similar to practices reported from other studies conducted in Latin America and Asia (Jabeen, Johnson & Allen 2010; Wamsler 2007; Wamsler & Brink 2014). Jabeen, Johnson and Allen (2010) found that residents of Korail in Dhaka (Bangladesh), who had access to land were engaged in the accumulation of assets, such as through the sale of expensive water to others in their community. Similar to the finding of this study, females in Korail, Dhaka (Bangladesh) were more engaged in this practice than men due to their extra resourcefulness in the family. Moreover, Wamsler and Brink (2011), also report from their study in Latin America and Asia that:

.....economic diversification is a practice that not only helps residents of these informal settlements to be less affected in the case of hazards/disasters, it also enables them to recover more quickly from hazards impacts (Wamsler and Brink 2011, p. 94).

This further highlights the need for recognising the differentiated capacities of residents of informal settlements in urban climate change adaptation research and planning.

7.3 Responses to Climate Change-related Hazards in the Built Environment

Urban dwellers who are not ‘passive victims’ of climatic hazards, often respond to climate change-related hazards based on their differentiated ‘adaptive capacities’ (Bulkeley 2013; Satterthwaite 2013). This ‘adaptive capacity’ alternatively referred to as ‘capacity to respond’, is the degree to which households and communities can respond to such climate-related hazards in their built environments (O'Brien et al. 2006; Satterthwaite 2013).

Determining how the study respondents may have responded to climate-related vulnerabilities, they were asked if they often respond to three main climate change-related hazards in their built environments and how. The hazards of flooding, excessive heat/heatwaves, and storms (rain/windstorms) were presented to respondents. The period considered for this assessment was the last one to two years when these climatic events last occurred and were perceived as most impacting to the household. Survey results from the four case study settlements are discussed in this section.

7.3.1 Responding to Flooding

As shown in Table 7.4, three main adaptive responses often taken by the respondents are climate-proofing of their dwellings. This was before flooding, or temporarily relocating before or during flooding, or opting to ‘do nothing’ when faced with floods. Most respondents in this study in Adedenpko (62.2 percent), Ga-Nshonaa (52.9 percent), Gbegbeyise (53.4 percent) and Old Fadama (58 percent) reported to often take structural measures by climate-proofing their dwellings, as illustrated from the last main flooding event. Structural responses adopted by the households, before the most recent flooding event, included the construction of embankments, increasing door sills, raising foundations of dwellings through the construction of platforms (as shown Plate 7.5) (Table 7.9). Doing so prevented floodwater from flowing into their properties. Moreover, the practice in which residents adopt structural measures were mostly engaged in by more female respondents (60.9 percent, 55.6 percent, 71.4 percent and 75.0 percent) than male respondents (62.5 percent, 52.7 percent, 50.4 percent and 55.4 percent) in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively. This was also more adopted by property owners (76.1 percent, 52.9 percent, 70.8 percent and 64.0 percent) than renters (39.3 percent, 39.5 percent and 38.9 percent) in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively.

In addition to the differences according to gender and tenancy statuses of the respondents, the choice of structural responses was spatially different. A higher percentage of the respondents in Adedenpko (62.2 percent) as compared to Ga-Nshonaa (52.9 percent), reported doing so (Table 7.4). This difference may be accounted for by several factors, including the nature of building materials used to construct their dwellings. The dwellings in Adedenpko were found to have been predominantly constructed of durable materials and more permanent, while dwellings in Ga-Nshonaa were predominantly temporary. Therefore, the nature of their dwellings may have made the choice of structural responses more feasible in Adedenpko than in Ga-Nshonaa.

However, over a quarter of the respondents in each study community, except Adedenpko (24.3 percent) reported opting to ‘do nothing’ ahead of the last flood event, while 13.7 percent in the same community reported having relocated temporarily to safe locations during the same (Table 7.4). This practice often involves moving household members, especially the aged and young, to safe locations. Moreover, the practice was more adopted in the households where males were the heads than those with female heads in three of the four study settlements, except Adedenpko (Table 7.4). In Adedenpko, 26.1 percent of the female-headed as compared to 11.2 percent of the male-headed households reported temporary relocation, as shown in Table 7.4.

Furthermore, the practice of temporarily relocating households was a preferred option for renter households than landlord households in all the study communities, except Ga-Nshonaa (only 15.2 percent of landlords did so) (Table 7.4). Overall, the findings show that, while relatively more female and property owners than male renter households adopted climate-proofing to flooding, temporal relocating before flooding was relatively more adopted by male-headed renter households than male property owners. This finding, thus suggests an association between the gender status of the respondents, their property rights and the patterns of responses to flooding; property owners seemed to have engaged more in climate-proofing activities than renters, possibly due to their superior property rights in their settlements. In Accra, as part of the tenancy agreements in informal settlements, tenants must seek consent from landlords/ladies before carrying out any structural modifications to their dwellings (Abeka 2014).

Furthermore, the practice of temporarily relocating before flood events was almost evenly adopted by the respondents in all the four study communities despite the differences in their physical locations, tenure security status and other socio-economic characteristics (Table 7.4).

However, opting to ‘do nothing’ before flooding was practised more among male-headed than female-headed households. It was also more practiced among renters than landlord households in all the study settlements, except in Ga-Nshonaa (Table 7.4). In general, female-headed households’ preference of preventive measures over impact minimising measures may be understood in the context of their nurturance role and a high priority for safety in their families (Abeka 2014; Roy & Sharma 2015).

Table 7.4: Responses to Flooding According to Gender, Tenancy Statuses in the Study Settlements

Settlement/community			Gender		Residential tenancy status		Total
			Male	Female	Landlord	Renter/tenants	
Adedenkpo	Took action: Climate proofing/modify structure	N	78	14	70	22	92
		%	62.4	60.9	76.1	39.3	62.2
	Relocated	N	14	6	4	16	20
		%	11.2	26.1	4.3	28.6	13.5
	Do nothing	N	33	3	18	18	36
		%	26.4	13.0	19.6	32.1	24.3
Ga-Nshonaa	Took action: Climate proofing/modify structure	N	68	5	73		73
		%	52.7	55.6	52.9	0	52.9
	Relocated	N	20	1	21	0	21
		%	15.5	11.1	15.2	0	15.2
	Do nothing	N	41	3	44	0	44
		%	31.8	33.3	31.9	0	31.9
Gbegbeyise	Took action: Climate proofing/modify structure	N	63	15	46	32	78
		%	50.4	71.4	70.8	39.5	53.4
	Relocated	N	17	2	2	17	19
		%	13.6	9.5	3.1	21.0	13.0
	Do nothing	N	45	4	17	32	49
		%	36.0	19.0	26.2	39.5	33.6
Old Fadama	Took action: Climate proofing/modify structure	N	72	15	73	14	87
		%	55.4	75.0	64.0	38.9	58.0
	Relocated	N	20	0	13	7	20
		%	15.4	0.0	11.4	19.4	13.3
	Do nothing	N	38	5	28	15	43
		%	29.2	25.0	24.6	41.7	28.7

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author’s construct, based on the household survey

Overall, the finding which suggests an association between the respondents’ tenancy status and choice of structural adaptive measures to flooding, is similar to that of Aboagye (2012) who reported more property owners than tenants did so in his sample. This is also corroborated by the work of Abeka (2014), who found that tenancy status of the respondents was among key determinants of households’ adaptive responses to flood hazards in three other informal settlements in Accra (Ghana). More landlords than tenants took structural responses in his study. Furthermore, the respondents’ pattern of differentiated responses through structural

action, temporal relocation, or ‘do nothing’ when faced with flooding, are consistent with practices documented among residents of informal settlements in other studies in Africa (Cissé & Sèye 2015) and Asia (Chatterjee 2010; Zoleta-Nantes 2002; Zoleta-Nantes 2000). This supports the often emphasised importance for adaption scholars to note the differentiated adaptive capacities of urban dwellers within the wider context of the city in their analyses.

Plate 7.4: Responding to Flood using Coconut Husk in Old Fadama



Source: Photograph by author, July 2017

Plate 7.5: Responding to Flood by protecting Foundation with a curb in Gbegbeyise



Source: Photograph by author, July 2017

7.3.2 Responding to Temperature Rise and Extremes

Similar to flooding, measures often adopted by the residents of the four study settlements to excessive heat involve climate-proofing their dwellings, opting to ‘do nothing’ or temporary relocating from their dwellings/sleeping outside it. Their adaptive responses to the most recent heatwave event mostly involved climate-proofing their dwellings in Adedenpko (56.8 percent) and Old Fadama (60 percent). However, 33.3 percent in Ga-Nshonaa and 47.3 percent in Gbegbeyise also reported this practice (Table 7.5). Structural measures reported in response to temperature extremes include insulating ceilings to reduce indoor heat, and perforating holes on walls to encourage indoor circulation of air (Table 7.9). However, more than nine (9) percent of respondents in each of the four case study settlements also reported sleeping outside their dwellings in response to excessive heat. Up to 12.2 percent, 27.5 percent, 15.8 percent and 9.3 percent of respondents in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama, respectively reported so. Comparatively higher proportions of the respondents claimed to have opted to ‘do nothing’ about excessive heat in all the four study communities; 31.1 percent, 39.1 percent, 37 percent and 30.1 percent of the respondents in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively reported this.

Furthermore, the option of ‘do nothing’, was more adopted by male respondents than female-respondents in the study communities, except for Ga-Nshonaa (44.4 percent female as compared to 38.8 percent male respondents reported so) (Table 7.5). Moreover, the other practice of ‘sleeping outside’ their dwellings was more adopted by renter households than landlord households in all the study communities, except for Ga-Nshonaa (only 27.5 percent of landlords did so) (Table 7.5).

Again, these differences in responses may be partly understood in the context of the mix of types of dwellings and physical locations of the various study communities. The predominantly temporal dwellings built with make-shift materials in Ga-Nshonaa may have made it less motivating for the residents to create vent holes on their dwellings. By contrast the residents of Adedenpko where dwellings were more permanent may easily adopt climate-proofing partly due to a lower risk of forced eviction in that community.

Overall, the findings show that relatively more female property-owning respondents than male-headed renter households in all the study communities claimed to have adopted climate-proofing activities. Similarly, the practice of ‘sleeping outside’ their dwellings was relatively more adopted by male-headed renter households than property owners in all the study communities (Table 7.5). This finding suggests a relationship between the gender status of the respondents, their property rights and the patterns of their responses to excessive heat. Property owners seemed to have engaged more in climate-proofing activities than renters, possibly due to their superior property rights as discussed earlier in section 7.2.2 of this chapter. Nevertheless, the finding that many landlord respondents opted to ‘do nothing’ in Ga-Nshonaa further suggests that a threat of eviction over their land more than housing ownership pattern may have mainly influenced respondents’ adaptive choices on their dwellings.

Table 7.5: Responding to Excessive Heat according to Gender and Tenancy Statuses of the Respondents

Settlement/community			Gender		Residential tenancy status		Total
			Male	Female	Landlord	Renter/tenants	
Adedenkpo	Climate proofing/modify structure	N	73	11	61	23	84
		%	58.4	47.8	66.3	41.1	56.8
	Sleep outside/relocate	N	13	5	5	13	18
		%	10.4	21.7	5.4	23.2	12.2
	Do nothing	N	39	7	26	20	46
		%	31.2	30.4	28.3	35.7	31.1
Ga-Nshonaa	Climate proofing/modify structure	N	42	4	46	0	46
		%	32.6	44.4	33.3	0	33.3
	Sleep outside/relocate	N	37	1	38	0	38
		%	28.7	11.1	27.5	0	27.5
	Do nothing	N	50	4	54	0	54
		%	38.8	44.4	39.1	0	39.1
Gbegbeyise	Climate proofing/modify structure	N	57	12	39	30	69
		%	45.6	57.1	60.0	37.0	47.3
	Sleep outside/relocate	N	20	3	4	19	23
		%	16.0	14.3	6.2	23.5	15.8
	Do nothing	N	48	6	22	32	54
		%	38.4	28.6	33.8	39.5	37.0
Old Fadama	Climate proofing/modify structure	N	74	16	71	19	90
		%	56.9	80.0	62.3	52.8	60.0
	Sleep outside/relocate	N	14	0	10	4	14
		%	10.8	0.0	8.8	11.1	9.3
	Do nothing	N	42	4	33	13	46
		%	32.3	20.0	28.9	36.1	30.7

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

Similar to the adaptive responses reported on flooding, the practices adopted to excessive heat in this study, are similar to measures reported in other studies conducted in Africa (Cissé & Sèye 2015), Asia (Chatterjee 2010; Zoleta-Nantes 2002; Zoleta-Nantes 2000) and Latin America (Wamsler & Brink 2014).

7.3.3 Responding to Storms (Wind/Rainstorms)

Measures typically adopted by the study respondents to minimise vulnerability to storms involve climate-proofing their dwellings before storms or relocating or opting to 'do nothing' during storms. Table 7.6 shows that, while the respondents' predominant adaptive responses to the most recent storm event involved structural modification of their dwellings in Adedenkpo (56.8 percent) and Old Fadama (56.7 percent), 29.0 percent in Ga-Nshonaa and 46.6 percent in Gbegbeyise also reported this practice. Examples of structural measures adopted included the

placing of heavy wood or stones on roofs of buildings to prevent the roof from getting blown off by strong winds and improving the foundation of the structure (Table 7.9). However, up to 10.8 percent, 26.8 percent, 14.4 percent and 14.0 percent of respondents in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively, reported having relocated temporarily during the most recent main storm event (Table 7.6). Similar to the pattern of responses to flooding and heatwaves, substantial number of respondents in Adedenpko (32.4 percent), Ga-Nshonaa (44.2 percent), Gbegbeyise (39.0 percent) and Old Fadama (29.3 percent) reported having opted to ‘do nothing’ about storms when this last occurred.

Moreover, the practice of climate-proofing their dwellings before the occurrence of a storm was found to have been adopted by more female-headed households (65.2 percent, 61.9 percent and 75.0 percent) than male-headed households in Adedenpko, Gbegbeyise and Old Fadama respectively (Table 7.6). Of these, more landlords (64.1 percent, 58.5 percent and 61.4 percent in Adedenpko, Gbegbeyise and Old Fadama respectively) than tenant households (Table 7.6) engaged in climate-proofing their dwellings. Furthermore, Table 7.6 shows that more tenants/renters (35.7 percent, 40.7 percent and 41.7 percent) than landlords opted to ‘do nothing’ about the last storm event. However, more males than female respondents’ households opted to ‘do nothing’ about the storm in three of the four study communities, except for Ga-Nshonaa.

Table 7.6: Responses to Storms (wind/rainstorms) According to Gender and Tenancy Statuses of the Respondents

Settlement/community			Gender		Residential tenancy status		Total
			Male	Female	Landlord	Renter/tenants	
Adedenkpo	Took action: Climate proofing/modify structure	N	69	15	59	25	84
		%	55.2	65.2	64.1	44.6	56.8
	Relocated	N	11	5	5	11	16
		%	8.8	21.7	5.4	19.6	10.8
	Do nothing	N	45	3	28	20	48
		%	36.0	13.0	30.4	35.7	32.4
Ga-Nshonaa	Took action: Climate proofing/modify structure	N	36	4	40	0	40
		%	27.9	44.4	29.0	0	29.0
	Relocated	N	36	1	37	0	37
		%	27.9	11.1	26.8	0	26.8
	Do nothing	N	57	4	61	0	61
		%	44.2	44.4	44.2	0	44.2
Gbegbeyise	Took action: Climate proofing/modify structure	N	55	13	38	30	68
		%	44.0	61.9	58.5	37.0	46.6
	Relocated	N	18	3	3	18	21
		%	14.4	14.3	4.6	22.2	14.4
	Do nothing	N	52	5	24	33	57
		%	41.6	23.8	36.9	40.7	39.0
Old Fadama	Took action: Climate proofing/modify structure	N	70	15	70	15	85
		%	53.8	75.0	61.4	41.7	56.7
	Relocated	N	21	0	15	6	21
		%	16.2	0.0	13.2	16.7	14.0
	Do nothing	N	39	5	29	15	44
		%	30.0	25.0	25.4	41.7	29.3

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

Overall, the survey results again suggest a relationship between the respondents' property rights, differentiated capacities and responses to storms. This finding has been reported by other studies conducted in similar contexts (Roy, Hulme & Jahan 2013; Wamsler & Brink 2014). Nevertheless, the diversity of adaptive measures that were adopted in this study further support the view that scholars working on adaptation practices need to pay attention to the peculiar socio-economic characteristics of residents of informal settlements relative to the wider city contexts in their analyses.

7.3.4 Responding to all three Main Climate Change-Related Hazards

Resulting from the reported structural adaptive responses to flooding, excessive heat or storms by the study respondents, it was found that at least 39.7 percent of respondents in each study community took structural responses to all the three major hazards (Table 7.7). However, the adoption of this practice was geographically differentiated, with half the respondents in Old Fadama (50.0 percent), compared to 46.6 percent in Adedenkpo, 39.7 percent in Gbegbeyise and a much lower proportion in Ga-Nshonaa (21.7 percent) reporting this practice.

Furthermore, more female respondents than male respondents in all the four study communities (65.2 percent, 44.4 percent, 61.9 percent and 75.0 percent in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively) reported having taken structural measures to all the three. Moreover, more landlords than tenants in all the four study communities (55.4 percent, 21.7 percent, 47.7 percent and 56.2 percent in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively) claimed to have taken structural responses (Table 7.7).

Nevertheless, Table 7.7 shows that over half the respondents of each study settlement did not take structural responses to all the three climate events when they last occurred in their communities. This includes respondents who opted to ‘do nothing’ in the face of the different climatic events. By opting to ‘do nothing’, many respondents, therefore, accepted their risk fatalistically while relying on their faith to ride out of it. Wamsler (2007) refers to such a practice as “.....*emotionally oriented strategies of adaptation*” (p.12), usually found in informal settlements across the globe.

Taken together, the respondents’ responses to multiple climate-related hazards in this study are similar to those reported in other studies on informal settlements in Africa (Abeka 2014), Latin America (Wamsler & Brink 2014) and Asia (Chatterjee 2010; Roy, Hulme & Jahan 2013; Wamsler & Brink 2014). This finding supports the view by Chatterjee (2010), Roy, Hulme & Jahan (2013) that, while residents of informal settlements are usually vulnerable to climatic hazards, the degree to which they become affected is usually dependent on their differentiated adaptive capacities. The nature and role of this ‘capacity to respond’ to multiple climate-related hazards have been further analysed and synthesised in section 7.5 of this Chapter.

Table 7.7: Respondents Who Took Structural Responses to Heat, Floods, and Storms by Gender and Tenancy Statuses

Settlement/community			Gender		Residential tenancy status		Total
			Male	Female	Landlord	Renter/tenants	
Adedenkpo	Yes	N	58	11	51	18	69
		%	46.4	47.8	55.4	32.1	46.6
	No	N	67	12	41	38	79
		%	53.6	52.2	44.6	67.9	53.4
Ga-Nshonaa	Yes	N	27	3	30	0	30
		%	20.9	33.3	21.7	0	21.7
	No	N	102	6	108	0	108
		%	79.1	66.7	78.3	0	78.3
Gbegbeyise	Yes	N	48	10	31	27	58
		%	38.4	47.6	47.7	33.3	39.7
	No	N	77	11	34	54	88
		%	61.6	52.4	52.3	66.7	60.3
Old Fadama	Yes	N	61	14	60	15	75
		%	46.9	70.0	52.6	41.7	50.0
	No	N	69	6	54	21	75
		%	53.1	30.0	47.4	58.3	50.0

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

Adaptive decisions by households to climatic hazards are often underlain by factors such as financial consideration, perceived effectiveness of the measure in relation to safety, and the knowledge of the adaptive option (Folke et al. 2002). This study, therefore, sought to examine the perceived main underlying factors of the respondents' choice of structural responses. Table 7.8 shows that most (80.3 percent, 83.3 percent, 75.9 percent and 66.7 percent in Adedenkpo, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively) respondents perceived the effectiveness of their adaptive measure as the main underlying factor for their action. This view was held by more female respondents than male respondents in all the study communities, except for Gbegbeyise; 50.0 percent of females as compared to 81.3 percent of males in that community reported so (Table 7.8). Furthermore, the value placed on the 'effectiveness' of an adaptive option was more held by landlords than renters in three of the four study settlements, except for Adedenkpo; 85.0 percent of the tenants compared to 78.4 percent of the landlords reported so (Table 7.8).

Following perceived effectiveness of the adaptation option, were the views that knowledge about the option and/or its financial burden was the main consideration of the household (Table 7.8). Respondents reporting these views were spatially different with comparatively higher proportions in Gbegbeyise (13.8 percent) and Old Fadama (22.7 percent) reporting the 'knowledge about the option' over its financial burden. In contrast, financial burden imposed

by the option was considered by more respondents than the knowledge about the option in Adedenpko (14.1 percent) and Ga-Nshonaa (16.7 percent) as shown in Table 7.8.

Table 7.8: Main Consideration for Structural Adaptation Option according to Gender and Tenancy Statuses of the Respondents

Settlement/community			Gender		Residential tenancy status		Total
			Male	Female	Landlord	Renter/tenants	
Adedenpko	Financial burden/cost	N	9	1	8	2	10
		%	15.3	8.3	15.7	10	14.1
	Effectiveness of adaption option/safety	N	46	9	39	16	55
		%	79.7	83.3	78.4	85	80.3
	Knowledge of option	N	3	1	3	1	4
		%	5.1	8.3	5.9	5	5.6
Ga -Nshonaa	Financial burden/cost	N	5	0	5	0	5
		%	18.5	0	16.7	0	16.7
	Effectiveness of adaption option/safety	N	22	3	25	0	25
		%	81.5	100	83.3	0	83.3
Gbegbeyise	Financial burden/cost	N	5	1	3	3	6
		%	10.4	10	9.7	11.1	10.3
	Effectiveness of adaption option/safety	N	39	5	26	18	44
		%	81.3	50	83.9	66.7	75.9
	Knowledge of option	N	4	4	2	6	8
		%	8.3	40	6.5	22.2	13.8
Old Fadama	Financial burden/cost	N	8	0	5	3	8
		%	13.1	0	8.3	20	10.7
	Effectiveness of adaption option/safety	N	40	10	41	9	50
		%	65.6	71.4	68.3	60	66.7
	Knowledge of option	N	13	4	14	3	17
		%	21.3	28.6	23.3	20	22.7

[Adedenpko, n= 69; Ga-Nshonaa, n= 30; Gbegbeyise, n= 58; Old Fadama, n= 75]

Source: Author's construct, based on the household survey

However, no marked differences were noticeable relative to the tenancy status of the respondents who viewed financial burden as the underlying factor for their adaptive response. More landlords than tenants perceived financial burden in Adedenpko (15.7 percent landlords to 10.0 percent tenants) and Ga-Nshonaa (16.7 percent landlords to no tenants), while more tenants than landlords reported so in Gbegbeyise (11.1 percent tenants to 9.7 percent landlords) and Old Fadama (20.0 percent tenants to 8.3 percent landlords). This finding may be understood in the context of the common challenge of limited financial resources among landlords and tenants in informal settlements (Roy et al. 2016).

Similarly, the view that knowledge of the adaptive option was the most important factor for some respondents was differentially held among landlords and tenants in the four study settlements. More landlords than tenants in Adedenpko (5.9 percent to 5.0 percent) and Old Fadama (23.3 percent to 20.0 percent) reported this importance of knowledge of their adaptive option in their decision to act (Table 7.8). In contrast, more tenants than landlords in Gbegbeyise (22.2 percent to 6.5 percent) who regarded the knowledge about the option as the most important factor, reported so. Overall, the majority of the respondents considered the safety of their households as of primary concern for their adaptive option. Moreover, except the respondents in Gbegbeyise, more female respondents than male respondents in the study communities considered the safety of their households, as shown in Table 7.8. This finding confirms explanations given by some social scientists who emphasise the nurturance role of women in their adaptive decision-making on hazards (Aboagye 2012a; Jones 2004). The scholars suggest that a head of household, when a female, tends to focus more on the safety of members of the household than other considerations. They often ensure that everyone is safe and together, before evacuating during a disaster (Aboagye 2012a; Jones 2004).

Furthermore, two reasons may have accounted for the importance of knowledge and financial resources as the underlying factors for adaptation choices for only less than 17 percent of respondents from each study community (Table 7.9). The first may be the limited costs involved in the type of structural responses reported in this study; they are typically small-scale physical/structural measures that tend to not require huge financial investment (Table 7.9). The second reason may be that the structural adaptive responses are simple measures which are known by the majority of those who adopt them.

Put together, the adaptive responses found in this study are both ‘preventive’ and ‘impact minimising’ relative to their potential impacts on the study respondents. According to Wisner, Gaillard and Kelman (2012), ‘preventive measures’ at the households’ level typically involve making choices such as relocating to safe locations to avoid being affected by climatic events, as in this study. By contrast, impact minimising measures are typically aimed at reducing losses associated with climatic events, such as modification of the built environment of the households (Wisner, Gaillard & Kelman 2012) as have also been found in this study. Overall, the choice of preventive and impact minimising measures reported in this study were also associated with respondents’ knowledge of climate change, which allowed them to make the various choices ahead of the events. Wamsler and Brink’s (2014, p. 94) study in Latin America

and Asia report that “households often drew upon their knowledge of the local environment to decide on” in their adoption of ‘preventive’ measures to climate change-related hazards.

Table 7.9: Adaptive Measures by the Residents of Informal Settlements in the Built Environment

Climatic impact	Specific structural responses before and or after events
Flood	<ul style="list-style-type: none"> • Construction of embankments or retaining walls to prevent flooding • Permanent closure of windows to avoid water • Increase of door sill levels • Raising the height of furniture in rooms to avoid flooding • Replacing building materials, e.g. mud for walls with bricks, wooden pillars with metal to address floodwater • Raising roof inclination, extending roof projections to discharge rainwater • Raising the foundations of dwellings to withstand floods better • Constructing drains in front of houses to facilitate the flow of floodwater • Widening and covering of drains to facilitate the flow of floodwater
Temperature changes and excessive heat	<ul style="list-style-type: none"> • Insulating ceilings, such as using recycled paper, styrofoam and cement bags, to reduce indoor heat • Constructing houses with ventilation openings • Perforating holes on walls to encourage indoor circulation of air • Use of outdoor spaces during excessive heat
Storms (wind and rainstorms)	<ul style="list-style-type: none"> • Placing wood or bricks on the roof to secure it. • Fixing the structure firmly on the ground with stones to withstand storms

Source: Synthesis from household survey questionnaires

Plate 7.6: Adapting Community Toilet due to Flooding by raising Foundation in Old Fadama



Source: Photograph by author, July 2017

7.4 Funding and or Support Network, Collective Action and Adaptive Responses

The importance of funding and or support for adaptive responses to climate-related and socio-economic vulnerabilities among the urban dwellers cannot be over-emphasised. This is significant given the urban poor's often limited capacity to respond to such 'double vulnerabilities' at limited periods (Blaikie et al. 2014). It is further emphasised by Isunju, Orach and Kemp (2016) that: "*adaptation in whatever form it takes does require resources*" (p.17). Furthermore, Blaikie et al. (2014) suggest that adaptive resources in urban areas usually include financial as much as in-kind/or material support. Moreover, funding and/or support and collective action in adaption are implied in the theoretical framework of this thesis (as depicted in component 4, Figure 3.2). This study, therefore, sought to assess the nature of the main mode of adaptation funding and/or support that is often available and/or depended upon to minimise the impact of climate change-related and/or social vulnerabilities by the respondents. The period considered for this assessment was the past one to two years.

As shown in Table 7.10, survey results show the predominance of personal/household resources/savings for adaptation funding in all the four study settlements. Up to 75.0 percent in Adedenpko, 71.7 percent in Ga-Nshonaa, 79.5 percent in Gbegbeyise and 70.7 percent in Old Fadama reported this. This is followed by micro-finance opportunities in three of the four study settlements, except for Gbegbeyise, where the next major source of support is categorised as 'other'. Group/joint contribution is the third main source of funding and/or support to the respondents in all the four study communities, but the proportions varied from a maximum of 12.7 percent of the respondents in Old Fadama to the lowest of 3.4 percent in Gbgbeyise. Other sources of funding and/or support reported, which varied according to the study communities, including support from government/institutions as well as non-governmental organisations/community-based organisations, as shown in Table 7.10. The sources of funding and/or support is therefore constituted by a network of local, city and international-level actors, as further discussed in the next sections.

Table 7.10: Perceived Main Funding and or Support for Adaptation by Percentage of Gender and Tenancy Statuses of the Respondents

Settlement/community		Gender		Residential tenancy		Total	
		Male	Female	Landlord	Renter/tenants		
Adedenkpo	Personal/household resources/savings	N	94	17	69	42	111
		%	75.2	73.9	75.0	75.0	75.0
	From group/joint contribution with others	N	8	3	5	6	11
		%	6.4	13.0	5.4	10.7	7.4
	Government institutions	N	2	0	1	1	2
		%	1.6	0.0	1.1	1.8	1.4
Ga-Nshonaa	Personal/household resources/savings	N	93	6	99	0	99
		%	72.1	66.7	71.7	0	71.7
	From group/joint contribution with others	N	9	1	10	0	10
		%	7.0	11.1	7.2	0	7.2
	CBOs/Trade Association	N	5	0	5	0	5
		%	3.9	0.0	3.6	0	3.6
Gbegbeyise	Personal/household resources/savings	N	101	15	52	64	116
		%	80.8	71.4	80.0	79.0	79.5
	From group/joint contribution with others	N	4	1	2	3	5
		%	3.2	4.8	3.1	3.7	3.4
	Government institutions	N	8	2	4	6	10
		%	6.4	9.5	6.2	7.4	6.8
Old Fadama	Personal/household resources/savings	N	92	14	81	25	106
		%	70.8	70.0	71.1	69.4	70.7
	From group/joint contribution with others	N	18	1	15	4	19
		%	13.8	5.0	13.2	11.1	12.7
	Micro finance institutions-MFI/local loans/susu	N	18	4	17	5	22
		%	13.8	20.0	14.9	13.9	14.7
Other (National/International NGOs, etc)	N	2	1	1	2	3	
	%	1.5	5.0	0.9	5.6	2.0	

[Adedenkpo, n= 148; Ga-Nshonaa, n= 138; Gbegbeyise, n= 146; Old Fadama, n= 150]

Source: Author's construct, based on the household survey

7.4.1 Personal/family and Micro-finance Sources

Funding for adaptive responses among the respondents is mainly from household resources; 75.0 percent in Adedenpko, 71.7 percent in Ga-Nshonaa, 79.5 percent in Gbegbeyise and 70.7 percent in Old Fadama reported this. Personal/family resources were reportedly applied to minimise socio-economic vulnerabilities or vulnerability from climate change-related hazards or both. This was found to have been differentiated among the different gender and tenancy statuses of the respondents, and across the study communities (Table 7.10). For instance, in terms of the gender of the respondents, more males than females in all the study communities reported personal/family sources of funding, as shown in Table 7.10. Moreover, respondents who reported this funding option were also almost evenly distributed according to their tenancy statuses, with only marginal differences between the proportions for landlords and tenants, as shown in Table 7.10.

On the other hand, respondents who funded their responses through micro-credit were found to have been spatially differentiated; 14.7 percent of respondents in Old Fadama, as compared to a lower value of 2.1 percent of respondents in Gbegbeyise reported doing so (Table 7.10). Resources from micro-financing were reportedly applied to minimise socio-economic vulnerabilities or vulnerability from climate change-related hazards or both. There were, however, no notable differences among landlord households and renter households who reported this option, as shown in Table 7.10. Overall, the resort to personal/household resources/savings and micro-credit sources to fund adaptation options is also a practice reported from studies conducted in similar contexts in Asia (Chatterjee 2010; Roy, Hulme & Jahan 2013). Moreover, the predominance of households/personal resources may be understood in the context of the 'limited to no support' the residents usually receive from the state (and its institutions), as elaborated on in the next section.

7.4.2 Institutional Responses to Climate Change-Related Hazards

Support for adaptive responses from state institutions to the respondents was reportedly limited both in proportion and geographic scope; less than a tenth of respondents from only two of the four study communities (6.8 percent of respondents in Gbegbeyise and 1.4 percent in Adedenpko) reported this (Table 7.10). This support is often in the form of distribution of relief items by the National Disaster Management Organization (NADMO) or local authorities after disasters. This view was expressed during focus group meetings, where a

participant noted that: “we received a few roofing sheets after the storm last year from the Sub-Metro Office. But they [roofing sheets] were not enough to replace my roof” (Participant #2, FGD, Gbegbeyise). Of these, while more males in Adedenpko received this support, more females reported so in Gbegbeyise (Table 7.10). It was also found that a slightly higher proportion of renters than landlords in this study reported receiving this support in both communities. The nature of support provided may have been influenced by the tenure security statuses of the communities; both Adedenpko and Gbegbeyise are recognised by the local authorities/state given their common pattern of land tenure as traditional ethnic ‘Ga’ settlements. This view is supported by an interviewee at the National Disaster Management Organisation (NADMO), who noted that:

...as for those squatters, we do not often give them relief items, because they are not organised. They are actually part of the problem that leads them to their exposure to such hazards in the first place. Why do they choose to settle in those dangerous places they do not even own, in the first place? (Interview #12).

Added to the view of the official from NADMO is a similar view expressed by a staff of the AMA Planning Department. In response to a question of whether the AMA supports adaptive practices in informal settlements, the interviewee referred to the systematic exclusion of residents of informal settlements from the city’s flood abating plans when he said:

We do plan many drainage projects and few sensitisation activities to increase awareness about climate change and to address the increasing flooding problem in the city. But we do not have the needed funds to implement many drainage projects. With regards to informal settlements, except those traditional communities where they own the land, we do not and will not implement any drainage projects there (Interview #13).

In addition to the views expressed by interviewees from the state institutions above, the position of the local authorities on climate change adaptation is also found in official documents of the Accra Metropolitan Assembly (AMA). For instance, the main document for climate change adaptation planning within the jurisdiction of AMA is the Medium Term Development Plan (MTDP) (2014-2017). Previously related plans that continue to be included in climate change adaptation planning in Accra include the content of the Strategic Plan for Greater Accra Metropolitan Area (GAMA) (UNDP & UNHABITAT 1992). It is also worth noting that, the guidelines for preparing the Medium Term Development Plans (MTDP) in Ghana do require local authorities to address climate change-related challenges throughout their jurisdictions (Chapter Two, section 2.4).

However, it was found through interviews with planning staff of Accra city authority that, implementation of key flooding mitigating projects in the city [example, Korle Lagoon Ecological Restoration Project (KLERP) and Urban Environmental Sanitation Project] often excluded residents of informal settlements in their locations. For instance, an examination of the most recent District Medium Term Development Plan (MTDP) (AMA 2014-2017) for the metropolis, shows the exclusion of Ga-Nshonaa and Old Fadama, from the city's drainage projects (pp.45-48). This exclusion was corroborated during focus group meetings that were conducted in the study communities when residents of Old Fadama expressed their concern, such as a member who noted that:

As for the AMA, they do not involve our community in their work. The drainage work and desilting of the Korle Lagoon have been going on, and they could have helped us in this community with drains, including connecting them to the lagoon for the easy flow of water here. But they [city authorities] refused to do so. The only time we see AMA Officials here is when they come to threaten us with evictions. They rather complain that we are responsible for the flooding problem in Accra (Participant #4, General Focus Group, Ga-Nshonaa).

Residents of Ga-Nshonaa, similarly to Old Fadama, were very concerned about their lack of involvement in the city's drainage projects and the consequent lack of benefits accruing to their community. This concern is exemplified by the comment of a community member during a focus group meeting in Ga-Nshonaa who noted that: *"We live here while the construction of the drains goes on in the other communities. No one [from the local authorities] has come to help us here."* (Participant #4, General Focus Group Discussion, Ga-Nshonaa).

Contrary to this finding that shows exclusion of some informal communities from institutional flood adaptive responses, it was found that the AMA had included activities for the forced eviction of the same settlements in the city's Medium Term Development Plan (MTDP) (AMA 2017, p.45). Added to this documented position on planned responses to flooding, the official verbal position of the local authorities on flood abating measures has also often been antagonistic. This is shown from the comment of a mayor of Accra in 2015 when he said:

.....yet we are in an era of climate change. Nobody ever thought that the level of rain that we had three weeks ago could come upon us; and if the right thing is not done, we may all not live for the next election. So it is not a matter of elections; it is a matter of doing what is right to save lives now. We will have to evict the people of Old Fadama to clear the way for the water to flow (Issah 2015 p.5).

Similar findings have been reported from previous studies conducted in Accra (Abeka 2014; Amoako & Inkoom 2018). The findings are also consistent with those of studies conducted in other cities in developing countries, such as by Chatterjee (2010). For instance, in her study on flooding in slums in Mumbai (India), Chatterjee (2010) reports that formal flood mitigation planning in Mumbai, is predominantly responsive to the needs of residents of the more formal part of the city, while residents of informal settlements suffer from forced evictions.

7.4.3 Collective Action and Response to Social and Climate-related Vulnerabilities

In addition to the individual responses reported, responses to climate-related vulnerabilities also involved reliance on varied forms of mobilisation and collective actions in the study communities. Mobilisation and collective agency do arise from both bridging social capital (benefits derived externally by belonging to a social group, class, ethnicity or other important socio-demographic characteristics) and bonding social capital (benefits from within a group by being a member) (Adger, Kelly & Ninh 2012).

Findings from the survey show that at least 31.5 percent of the respondents in Adedenpko (59.5 percent), Ga-Nshonaa (34.8 percent), Gbegbeyise (31.5 percent) and Old Fadama (37.3 percent) claimed to belong to groups/associations (Figure 5.6). However, Table 7.10 shows that respondents who claimed to have received group support in adaptation were comparatively lower than those who claimed to belong to groups; 7.4 percent, 7.2 percent, 3.4 percent and 12.9 percent of respondents in Adedenpko, Ga-Nshonaa, Gbegbeyise, and Old Fadama respectively reported as receiving this support. Furthermore, those who received this support differed according to their different gender and tenancy statuses and across the study communities. For instance, more female than male respondents in all the study communities, except for Old Fadama reported this support option (Table 7.10).

However, while marginally more respondents who reported this option of funding were renters in Adedenpko and Gbegbeyise, more respondents in Ga-Nshonaa and Old Fadama were landlords, as shown in Table 7.10. Examples of groups mentioned during focus group meetings in the various case study communities included Fishermen Associations in both Gbegbeyise and Ga-Nshonaa. Others are community-based organisations such as Old Fadama Development Association (OLDFADA) in Old Fadama, as well as Landlords/ladies' Association in Gbegbeyise (Table 7.11). Overall, the findings suggest that the benefits driven from group membership for adaptation in the various study communities are sub-optimal.

Nevertheless, less than ten (10) percent of the respondents in each case study community: Adedenkpo (6.1 percent), Ga-Nshonaa (3.6 percent), Gbegbeyise (8.2 percent) and Old Fadama (2.0 percent) reported having received adaptive support from national and/or international non-governmental organisations, referred to as “other”. Examples of these organisations include People’s Dialogue on Human Settlements, an affiliate of Slum/Shack Dwellers’ International, and the Centre for Public Interest Law (CEPIL). The organisations were reported to have offered both material and non-material support to residents of Old Fadama as was voiced by a resident who said that:

PD [Peoples’ Dialogue on Human Settlements] and other NGOs have been helping us to sensitise community members about flooding and other environmental hazards (Participant # 2, General Focus Group, Old Fadama).

Overall, the reported support received from local groups, as well as national and international non-governmental organisations, therefore assisted the respondents in minimising their socio-economic and climate change-related vulnerabilities.

Table 7.11: Emergent Non-state Actors

Settlement	Group/organisations
Adedenkpo	Plumbers Association; Young Youth Association; Association of Market People; Kayayo/Porters Association; Scrap Dealers Association; Tahubaba Association; Political parties.
Ga-Nshonaa	Society, Canoe Owners Association, Office of Chief Fisherman, Peoples Dialogue on Human Settlements (PDHS), Ghana Federation of the Urban Poor (GHAFUP), Shark/Slum Dwellers International (SDI); Political Parties
Gbegbeyise	Traditional Authority, Paradeso Youth Club, Landlords Association, Trades Associations; Political Parties; Global Communities.
Old Fadama	OLDFADA, Peoples Dialogue on Human Settlements (PDHS), Ghana Federation of the Urban Poor (GHAFUP), Shark/Slum Dwellers International (SDI); Land for Life, Centre for Public Interest Law (CEPIL); Centre for Housing Rights and Evictions (COHRE); Ghana Youth Porters Association (GYPA); Political Parties; Religious groups.

Source: Synthesised from focus group discussions in communities

Moreover, non-state actors in the case study localities have also been reported to have supported adaptive responses to climate change-related hazards. For instance, it was reported during focus group meetings that Old Fadama Development Association (OLDFADA) often organises communal labour-based activities to unclog their waterways, before the flooding

season commences. In addition to this, OLDFADA enforced a rule in Old Fadama that required residents to use good quality electricity cables to wire their dwellings, as has been reported by Farouk and Owusu (2012). This intervention was associated with reported moderate reductions in the incidence of fire outbreaks in Old Fadama.

Moreover, adaptive responses reported in Old Fadama were similar to those reported in Adedenkpo where residents claimed they occasionally organise communal labour to unclog drains before and after the rainy season. This notwithstanding, the activities reported often excluded squatters in the community, as was noted by a community member during focus group meeting who said that:

We the permanent community members here sometimes clean up the gutters [drains] in this community. As for those squatters, they do not like to be part of it, and we do not even invite them either (Participant # 2, General Focus Group, Adedenkpo).

The reported exclusion of squatters from communal adaptive activities in Adedenkpo is similar to what was found in the socially fragmented community of Ga-Nshonaa. It was reported during focus group meetings that, the community does not regularly organise communal cleaning up activities, given disagreements between different groups of residents as noted by this discussant who said: “*we occasionally organise clean-ups here, but only the fishermen do so. We do not invite the squatters who live in this community*” (Participant #6, General FGD, Old Fadama). Resulting from this, the few communal activities reportedly organised in Ga-Nshonaa, were found to have little success in helping the residents to respond to climate-related vulnerabilities.

Reported communal responses in Gbegbeyise have been found to differ from those that were reported in Ga-Nshonaa, but similar to communal practices reported in Adedenkpo. In Gbegbeyise, focus group participants reported often mobilising and unclogging choked drains and laying of sandbags along the shoreline to protect houses from sea inundation. This was mentioned during focus group meetings by a discussant who said that:

Every year, we mobilise our community to clean up the few gutters [drains] here, before the rains start. We also lay sandbags along the beach to reduce the erosion (Participant # 2, General Focus Group, Gbegbeyise).

Overall, the collective responses found in this study were geographically differentiated and related mainly to the tenure security status of the respondents in each study community.

The communal practices reported in this study are also consistent with findings reported from studies conducted in Rio de Janeiro, Brazil and El Salvador (Wamsler & Brink 2014), and Dhaka city in Bangladesh (Jabeen & Guy 2015; Jabeen, Johnson & Allen 2010). For instance, Jabeen, Johnson, and Allen (2010) found that residents of Korail in Dhaka often organised themselves and engaged in communal clean-up activities in preparation for the occurrence of cyclones. The gap in communal responses found in the squatter communities is mainly associated with the lack of tenure security as has been reported elsewhere (Bartlett 1997; Roy, Hulme & Jahan 2013).

7.4.4 Collective Action and Response to Tenure Insecurity

Collective efforts reported by respondents in this study also sought to respond to their contextual vulnerability of tenure insecurity. Responses to the vulnerability of tenure insecurity influence the ‘adaptive capacity’ of residents of informal settlements as it has potential to encourage informal dwellers to invest in their dwellings in response to climatic hazards (Wamsler and Brink 2014). Among responses to the vulnerability of tenure insecurity, study respondents reported turning to the local councillors and other community leaders for advocacy support to prevent their eviction from their land. Illustrating this view, a resident reported how they sought help from their assemblyman (local councillor) to lobby the city authorities to delay their eviction from sections of the community as he said:

Except for the assistance of the Assemblyman [local councillor], no one is willing to assist us here. Last time the AMA came to warn us here, he went to plead with not to evict us from here (Participant # 4, General Focus Group, Adedenpko).

This was similar to findings from Ga-Nshonaa, where residents reported seeking help from a community-based organisation to prevent an imminent eviction of their community in 2015. It must be noted, however, that the planned forced eviction, was not solely initiated by the AMA, as it was instigated by some fishermen who only work in this community (Ga-Nshonaa). Focus group discussion with fishermen in Ga-Nshonaa, revealed the nature of this antagonism between the squatters and fishermen as one fisherman noted that:

We the fishermen, reported those people sleeping there [squatters] to the city authorities because many thieves had moved from Old Fadama to settle with them. We do not want too many bad boys coming in to live in this community, as they end up stealing our working gear (Participant #3, Fishing Focus Group, Ga-Nshonaa).

Responses to tenure insecurity in the case of Old Fadama were different from the other communities, as they involved advocacy and resort to court action. Community members

reported taking court action to prevent their forced eviction by seeking help from the Centre on Housing Rights and Evictions (COHRE) and Peoples Dialogue on Human Settlements. Through this, the community received legal assistance from the Centre for Public Interest Law (CEPIL). This enabled them to challenge an intended forced eviction by the city authorities in court, as voiced by a community leader who said:

I still remember that time, when the AMA was constantly on our necks to get rid of us. They [AMA] gave us an ultimatum to leave Old Fadama, failure of which they were to demolish our belongings. So we took the matter to court. But we lost the case in court (Participant #6, General FGD, Old Fadama).

Although the community lost the case, the residents contend that the court action was successful in halting their planned forced eviction to the present day.

The reported alliances that are forged by residents of informal settlements with civil society organisations in this study have also minimised concerns for the exclusion of the urban poor in the governance of Accra. For instance, a key informant interview conducted with People's Dialogue on Human Settlements revealed that the organisation successfully lead the Ghana Federation of the Urban Poor (GHAFUP) to participate in meetings with the city authorities in bridging the engagement gap between the two groups. This was noted by an interviewee who said:

We have successfully organised meetings between the city authorities and GHAFUP, to deliberate on different ways to improve the participation of the urban poor in the governance of the city. This has led to the city authorities' current recognition of GHAFUP as the umbrella body for the urban poor. So they now get invited to important stakeholders' events at AMA (Interview #I11).

In addition to the work of Grant (2009), the work of Gough and Yankson (2011), Roitman (2019a; 2019b), and Wekete (1992) has also reported the emergence of these community-based organisations and their support of the urban poor in the governance of cities. For instance, Wekwete (1992)'s study in southern Africa reported that:

...with the support of non-state actors, the urban poor is now predominant and in most cases are transforming the city to meet their needs, often in conflict with official laws and plans (p.15).

This has been shown to allow the urban poor to improve upon their overall 'capacity to respond', to environmental hazards.

Overall, the combination of funding and/or support relied upon for minimising social and climate-related vulnerabilities in this study, show a complex network of actors similar to those

reported from other studies (Adelekan 2010; Chatterjee 2010; Jabeen, Johnson & Allen 2010). Chatterjee (2010) found that residents of slums in Mumbai also adopted and or relied upon different types of adaptation funding and/or support mechanisms to minimise their socio-economic vulnerabilities and flooding. However, no respondent in this study reported the use of flood insurance, although Aboagye (2012) reported that five (5) percent of his sample, did apply flood insurance as a means of funding adaptation to flooding in Accra (Ghana).

Added to these findings is the overarching finding that, very little social learning occurred within the institutional and communal adaptation responses to climate change-related hazards in the four study communities. In urban climate change governance, social learning which involves “*the promotion of strong local social cohesion and mechanisms for collective action*” is often viewed with the potential to promote the sustainability of adaptation interventions (Adger, Arnella & Tompkins 2005, p.138). This occurs when state institutions involved in adaptation processes include and formalise the participation of all key actors, creating the needed learning and accumulation of knowledge (thereby, building their social resilience) for responding to future hazards (Adger, Arnella & Tompkins 2005).

7.5 Synthesis: who adapts to which multiple climate change-related hazards and why in informal settlements in Accra?

A response to the question of: “who adapts to which multiple climate change-related hazards and why in informal settlements” also involves measurement of respondents’ adaptive capacity to the multiple climate change-related hazards they face. In order to establish the main factors that are associated with respondents’ responses to climatic hazards, binary logistics regressions were conducted. Generating crude odds ratios (CORs), at 95 percent confidence interval (CI), and a level of significance of $p < 0.05$, the odds ratios and levels of significance are shown in Appendix 8.

Key household characteristics considered for this analysis were age, gender, educational level, associational life, length of stay, number of household members, tenancy status, and nature of the economic activity of the household. Other factors were the location of the respondent’s economic activity (when they worked), annual household income, challenge over land or space/threat of eviction, and the most important thing affected by the climate change-related hazard (sensitivity to climate change hazards, based on findings in Chapter Five). Together, the parameters considered are more extensive than have been found previously considered for

determining adaptive capacity and response options to flooding in the context of informal settlements in the literature. For instance, Abeka (2014) considered gender, tenancy, education, income/wealth, household size, elevation level of the dwelling, and wall material as potential factors that influence adaptation to flooding in Accra. Similarly, for Braun and Aßheuer (2011), important parameters considered were the education, gender, income and level of floodwater, as the potential influencing factors for adaptation options to flooding in Dhaka (Bangladesh).

Results of this analysis showed statistical significance for the tenancy status, ‘threats of eviction’ over the land, and respondent’s income relative to whether they took adaptation action (structural response) or not to the three main climate-related hazards (Table 6.13). Thus, specifically, tenants (COR 0.616, 95 percent CI 0.366-0.673, $p=0.059$) were less likely to take adaptive action than landlords given their limited property rights, as compared to landlords who have superior property rights to easily take adaptation decisions. Scholarly work in Accra has shown that tenancy agreements in informal settlements, often require tenants to seek the consent of landlords before any housing maintenance works are carried out. However, in Accra, landlord-tenant relations are often characterised by disagreements between the two actors (Arku, Luginaah & Mkandawire 2012; Asiedu & Arku 2009).

In addition, respondents who perceived a ‘threat of eviction’ over their land (COR 2.070, 95 percent CI 1.232-3.479, $p=0.006$) were less likely than those who did not perceive a threat of eviction to take adaptive action. Households will not readily invest in their dwellings if they perceive that the dwellings will be destroyed during an eviction. This insecurity of tenure may also explain the finding that living in Gbegbeyise (COR 2.605, 95 percent CI 1.019-6.659, $p=0.046$), was positively associated with respondent’s likelihood for taking adaptive action relative to Old Fadama (Appendix 8).

Furthermore, respondents whose households earned less than GH¢7,000 a year (COR 0.545, 95 percent CI 0.317-0.395, $p=0.028$), were less likely than those who earned higher than GH¢7000 to take an adaptive response given their limited resources. The finding that associates adaptive responses to tenancy status is consistent with that of Aboagye (2012), who reported that property owners more easily adopted structural measures to flooding than tenants in his sample. Similarly, Abeka (2014) reported that the tenancy status of the respondents in his sample was among key variables that correlated with the household’s adaptive responses to

flooding in Accra. The finding is also consistent with that of Isunju, Orach and Kemp (2016) in Kampala (Uganda) who reported that landlord households were more likely and able to adapt to flooding than tenant households. This was accounted for by their superior property rights.

However, other key variables such as age, gender, educational level, ethnicity, household size, length of stay, nature of economic activity engaged in, the location of work, and their sensitivity to the climate-related hazards were not found to be statistically significant. These factors were not associated with the 'adaptive capacity', and responses of the household to the three climatic hazards. Overall, these findings depart from the findings by Braun and Aßheuer (2011), who reported households' education and income as key factors associated with their adaptive responses to flooding in Dhaka (Bangladesh).

7.6 Conclusion

This chapter has unravelled the adaptive responses by residents of four informal settlements in Accra to climate change-related hazards and their social vulnerabilities. The findings are three-fold.

Firstly, respondents in this study adopted economic measures to address their socio-economic contextual vulnerability by diversifying their livelihood activities such as changing from fishing to trading and other economic activities, as well as transforming climatic hazards to positive economic opportunities. This transformation of climate-related hazards to improve their economic conditions was not associated with the gender or tenancy status of the respondents; it was, however, associated with their household sizes. Households' heads whose households had more members were more engaged in the transformation of climatic activities to minimise their socio-economic vulnerabilities. This may be accounted for by the fact that larger households require more resources to respond to their socio-economic vulnerabilities as well as an additional burden of climate change (Cissé & Sèye 2015).

Secondly, the chapter shows that the adaptive responses by households to multiple climatic hazards in this study were associated with the household tenancy, household income and their perception of 'threats of eviction' over land in the various study communities. More specifically, landlords, residents who earned higher annual income than GH¢7000, and residents who did not perceive 'threats of eviction' over their land, were more likely to take structural adaptation action than the converse. Thus, the socio-economic characteristics of the

households that influence their adaptive responses to multiple climatic hazards were the household tenancy status, income and the nature of perceived 'threats of eviction' over their land.

Finally, this chapter reveals that households relied on a complex network of actors and support to respond to their contextual vulnerability and climate change-related hazards. Specifically, households mostly funded their adaptive responses from household resources/savings, while institutional adaptation support has been limited to the distribution of short-term relief items after flooding and storms. Added to this are reported forced eviction of informal settlements by the city authorities to implement formal flood adaptive responses in Accra. Furthermore, the adaptation strategies adopted by the local authorities in Accra do not lend themselves to social learning and co-operative governance with residents of informal settlements. The residents of the four informal settlements in this study, therefore, had to rely on a complex network of actors and in different degrees of collective action in responding to their multiple vulnerabilities including climate change-related hazards.

8 CHAPTER EIGHT: FINDINGS, IMPLICATIONS AND CONCLUSION

8.1 Introduction

This concluding chapter of the thesis presents the main findings and implications towards urban policy-making and climate change adaptation planning practice. The chapter has been organised into seven sections. It starts by presenting the overall aim, related objectives and research questions, to contextualise the extent to which the research questions have been answered, and the objectives met. Therefore, the major findings from the research questions are presented in the second section. Section three is a discussion of the implications of the findings for vulnerability and climate change scholarship. Following this are the implications of the findings of the study for urban policy-making and climate change adaptation planning practice in Accra and similar contexts. Potential areas for future are then presented next before the contribution of the research and overall conclusion of the chapter.

8.2 Research Aim, Objectives and Questions

The overall aim of this thesis was to examine the factors that drive the vulnerability and nature of adaptive responses of the residents of informal settlements to climate change-related hazards as their contextual experience in Accra (Ghana). Specific objectives related to this aim were to:

- a) Examine the drivers associated with the vulnerability of residents of informal settlements including climate change-related hazards as a contextual experience in Accra;
- b) Investigate the potential influence of the socio-economic context of the residents of informal settlements on their knowledge and capacity to respond to potential climate change in Accra; and
- a) Examine who adapts to what and why in the context of climate change-related hazards and social vulnerabilities in informal settlements in Accra.

Pursuance of these research objectives was through collecting and analysing both primary and secondary data, applying a mix of methods, in response to three main research questions. The first main question of the thesis is: Which factors drive the vulnerability of residents of informal

settlements including climate change-related hazards as a contextual experience in Accra? The two related sub-questions are: 1) which social, economic, political and institutional factors are associated with the perceived vulnerability of residents of informal settlements to climate change-related hazards? and 2) what are the most frequently experienced climate change-related hazards among the residents of informal settlements?

The second main research question which focused on the respondents' knowledge of climate change is: In which way does the context of residents of informal settlements influence their knowledge and 'capacity to respond' to potential climate change? This question involves three sub-questions as 1) what are the perceptions of climate-related environmental changes among residents of informal settlements and the synergies with scientific knowledge on climate change-related phenomena? 2) how do socio-demographic characteristics of residents of informal settlements influence their knowledge of climate change and variability compared to the perspectives of state officials on the same? and 3) how does the socio-political context of residents of informal settlements influence their access to an early warning on climate change-related hazards?

The final main research question is: Who adapts to what and why in the context of climate change-related hazards and social vulnerabilities in informal settlements? This involves three sub-questions as 1) what responses are adopted to minimise socio-economic contextual vulnerabilities, and how do they relate to climate change/variability in informal settlements? 2) how do socio-economic characteristics of residents of informal settlements relate to their adaptation options to climate change-related hazards in their built environments? and 3) what funding and/or support mechanisms are available for minimising social contextual and climate change-related vulnerabilities in informal settlements? Overall, answers to these research questions have been presented and discussed in Chapters Five, Six and Seven of this thesis, a summary of which are presented in section 8.3 of this chapter.

Put together, the central argument of this thesis is two-fold. Firstly, patterns of differentiation in vulnerability among residents of informal settlements are underpinned by socio-economic, political and institutional factors which exposed them to climate change-related hazards as a contextual experience in Accra. However, secondly, the respondents who are active agents, do exercise their agency in responding to their vulnerabilities, including climate change-related

hazards. This argument has been pursued within theoretical boundaries of social vulnerability to hazards, specifically, underpinned in political ecology and actor-oriented theory.

8.3 Key Findings to the Research Questions

In this section, key findings of the study are presented in relation to the three main research questions. First are the perception and drivers/factors associated with vulnerability to climate change-related hazards as a contextual experience, in relation to findings under question one. Following this, is the theme of the influence of the socio-economic and political contexts of the study respondents' knowledge on climate change in relation to the second research question. The final theme, which relates to the findings of the third research question is the 'differentiated capacities and responses to both social and climate change-related vulnerabilities' among the study respondents.

8.3.1 Perception and Drivers Associated with Vulnerability to Hazards

Overall, the findings of this study show that the vulnerability of residents of the four informal settlements to hazards is contextual, socially differentiated and experienced. More specifically, the specific socio-economic, political and institutional-related factors/drivers associated with respondents' perceived vulnerability were their tenancy status, length of stay, a perception of 'threat of eviction' over their land, as well as the size of household income. Therefore landlords, respondents who stayed longer in their communities and those who earned higher incomes, as well as those who did not perceive a threat of eviction over their land, were less likely to perceive themselves as vulnerable to hazards. In contrast, tenants, respondents who stayed over a shorter period, those who reported lower incomes and as well as those who perceived 'threats of eviction' over their land, were found more likely to have perceived themselves as vulnerable to hazards. Overall, however, the most significant of these factors was the perceived 'threats of eviction' over their land. Therefore, the physical climate change-related hazards to which respondents were exposed were not associated with their perceived vulnerability to hazards. Also, other important socio-economic and political factors such as age, gender, ethnicity, educational level, belonging to a group, perception of involvement in the city's governance, as well as knowledge of development regulations were not associated with the respondents' perceived vulnerability.

Finally, the nature of land ownership among respondents of the four study communities may have accounted for this significance of ‘threats of eviction’. While Old Fadama and Ga-Nshonaa are squatter settlements, Gbegbeyise and Adedenpko are traditional ethnic ‘Ga’ settlements. However, some respondents in Adedenpko who are also squatters were exposed to threats of eviction. Added to threats and actual evictions in the study communities, planning and provision of social amenities by the city authorities was also found to be based on the nature of land ownership in the study communities. Resulting from this, while the local authorities have provided solid waste collection services to the two communities of Adedenpko and Gbegbeyise, this was different for the residents of the squatters’ settlements in this study: Ga-Nshonaa and Old Fadama. Residents of these two settlements were therefore found without access to state-supported amenities, while they also more faced threats of eviction over their land. This situation has differentially influenced the respondents’ living conditions, their ability to invest in their dwellings and to reduce their exposure to climate change-related hazards.

8.3.2 Influence of Socio-economic and Political Contexts on Knowledge of Climate Change

The findings from the study’s second question show the influence of the socio-economic and political contexts of the respondents on their knowledge of climate change in three main ways. Firstly, in terms of the perception of changes in potential climate change-related factors, most (at least 80.7 percent in each community) respondents reported changes in temperature, rainfall patterns (97.3 percent), floods (72 percent) and storms (89.0 percent) in their environment. Moreover, at least 87 percent in the two shoreline communities reported a perception of an increase in coastal erosion, and at least 89 percent in sea level rise in the same communities. There was also concordance between the respondents’ views on temperature rise, rainfall patterns, coastal erosion, sea level rise, storms, and saltwater intrusion, and scientific data on the same. By contrast, respondents’ claims of increases in flooding, were not supported by scientific studies on the same phenomena. Nevertheless, the findings show concordance between scientific data and the majority of respondents’ views about the timing of occurrence of rainfall (May to October), excessive heat (December to March), storms (May to October), and flooding (May to October) in Accra.

Secondly, most (97.3 percent) respondents were found to be aware of climate change, but this was not associated with the educational level of the respondents, while their educational levels were associated with the perceptions about the causes of climate change. Further, most (at least

74.6 percent in each community) respondents reported having perceived climate change as caused by local anthropogenic activities, while those with limited to no formal education mostly (at least 83 percent in each community) associated climate change with the 'Act of God'. Nevertheless, community members and city authorities in this study disagreed on the causes of flooding; state officials blame the residents for building their dwellings illegally and blocking waterways which cause flooding. In turn, the residents blamed city authorities for not providing drainage infrastructure to facilitate the flow of rainwater in their settlements. This externalisation of the blame for the cause of flooding by the actors, therefore, poses a challenge for how they may work together to address a significant climate-related hazard (flooding).

Finally, it was found that accessibility to sources of early warning information from formal state institutions was limited, and was perceived by the majority (at least 75 percent in each community) of respondents as unsatisfactory for each of NADMO, Ghana Fire Service and Ghana Meteorological Agency. Moreover, the nature of knowledge of climate change among respondents was differentiated according to their age and length of stay in their communities. Older respondents who lived longer in their communities were found to more readily realise climate change-related changes than younger respondents. Together, the nature of the respondents' socio-economic and political contexts had differentiated influence on their ability to successfully cope with climate change-related hazards.

8.3.3 Differentiated Adaptive Capacities and Responses to Social and Climate-related Vulnerabilities

Findings from this study's third question show that respondents' 'capacity to respond' and actual responses to their social and climate-related vulnerabilities differed among households and communities in three main ways. Firstly, economic measures adopted to minimise socio-economic vulnerabilities involved diversification of livelihood activities, including the transformation of climate-related hazards to positive livelihood opportunities. This was found to be associated with the size of the household, but not associated with the tenancy status of the respondents. Increased economic demands on larger household sizes that require them to engage in additional means of income generation may have influenced this pattern of adaptive response.

Secondly, respondents were found to mostly adopt structural measures to minimise the impacts of the multiple climate-related hazards they faced. This was found to be associated with the household tenancy and income statuses, as well as their perception of ‘threats of eviction’ over their land. Specifically, many respondents (62.2 percent, 52.9 percent, 53.4 percent and 58 percent in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama, respectively) reported having taken structural measures to minimise their vulnerability to flooding. This is similar to those who reported so to excessive heat (56.8 percent, 33.3 percent, 47.3 percent and 60 percent in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama, respectively) and to storms (56.8 percent, 29.0 percent, 46.6 percent and 56.7 percent in Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama respectively). However, over a quarter of the households surveyed in each study community had not taken action against the last flooding experienced, storms experienced, and excessive heat experienced.

Furthermore, to protect children and other vulnerable members of their households from hazards, respondents reported to also relocate them out of the community or to the least affected parts of their communities. Overall, landlords and residents who earned higher annual incomes, and those who did not perceive and or experience ‘threats of eviction’, were found more likely to take structural adaptation action than those who were renters, perceived ‘threats of eviction’ and earned lower incomes.

Additionally, households relied on a complex network of actors and support network to respond to their contextual vulnerability and climate-related hazards. Specifically, households mostly (75.0 percent in Adedenpko, 71.7 percent in Ga-Nshonaa, 79.5 percent in Gbegbeyise and 70.7 percent in Old Fadama) funded their adaptive responses from personal/household resources. Relatively lower percentages of the respondents (7.4 percent, 7.2 percent, 3.4 percent and 12.9 percent of respondents in Adedenpko, Ga-Nshonaa, Gbegbeyise, and Old Fadama respectively), also reported relying on collective adaptive responses in the various settlements. Moreover, residents of Adedenpko, Gbegbeyise and Old Fadama, were found to organise themselves through Community-based Organisations such as Landlords Associations, to respond to climate change-related hazard, while residents of Ga-Nshonaa, a reported to hardly organised themselves for communal responses. Furthermore, the community-based responses were found to have included responding to tenure insecurity. This was intended to improve

their security of tenure for responding to climate change-related hazards among residents of Old Fadama.

Nevertheless, the structural-centred approach to disaster management, that guides institutional responses to climate change in Accra has only been limited to the distribution of short-term relief items after disasters. This was often, after flooding and storm events, while residents of informal settlements without the security of tenure reported to their evictions by the AMA, to facilitate the implementation of flood adaptive responses in other communities. Altogether, the adaptation strategies reported by households and the local authorities were found not to lend themselves to social learning and co-operative governance. Moreover, the adaptation practices found in this study do not promote social resilience in the communities and Accra.

8.4 Discussion: Implications of Perceptions and Agency for Vulnerability and Hazards Discourse

This thesis highlights a number of key issues of relevance to the theory and discourse on social vulnerability and responses to hazards. Noteworthy is the role of perception, knowledge and actor agency as presented in this section.

8.4.1 Perception and Differential Vulnerability to Hazards

Analysing the vulnerability to hazards has engaged the attention of scholars working in cities in developing countries (Blaikie et al. 2014; Cannon 2000). This attention has led to two main views of vulnerability based on the theoretical focus – social (Blaikie et al. 2014; Cannon 2000) or biophysical climate-related hazards (Rogers and Woodroffe 2016). While the latter's thrust is on physical climatic hazards, the former focuses on the underlying social conditions which expose people to the different impacts of the climatic hazards. More elaborated is the view that by social vulnerability theorists that, it is the socio-economic, political and institutional contexts of households and communities that influence their vulnerability to hazards (see Blaikie et al. 2014; Cannon 2000; Cutter et al. 2009; Pelling 1997). In this respect, many scholars have argued that the urban poor tend to be disproportionately vulnerable to impacts of climate change in cities (Cardona 2004; McGranahan et al. 2007; Pelling 1997). This is often accounted for by factors such as a lack of hazard-reducing infrastructure in their communities, residents' limited capacity to construct better quality housing or move to less dangerous locations, and the absence of state legal and financial protection (Dodman and Satterthwaite 2008; McGranahan et al. 2007).

Similarly, in this study, the wider social and ecological contexts of the respondents' influenced the vulnerability of the majority's decision to settle in their present hazardous locations exposing them to hazards. This context has also influenced the type of work the respondents do, the constraints they face in their work as well as the assets they can mobilise to minimise their exposure to hazards. Most community members were found engaged in precarious informal work that is very susceptible to general shocks and stresses making it difficult for them to construct better quality housing in their locations.

Furthermore, by occupying lands with varying degrees of tenure security, the nature of land ownership has also differentially exposed the respondents to hazards as commonly reported in other informal settlements in South-East Asia (Wamsler 2007; Wamsler & Brink 2014). Residents of Adedenpko and Gbegbeyise enjoy security of tenure while those in Ga-Nshonaa and Old Fadama are constantly under threat of eviction. Therefore, respondents from Adedenpko and Gbegbeyise were found to have more perceived themselves involved in the governance of Accra. By contrast, residents of Old Fadama and Ga-Nshonaa were found uninvolved in the governance of the city. Yet, scholars such as (Blaikie et al. 2014) have emphasised the need for urban dwellers' involvement in urban governance as it influences their access to public infrastructure services.

Resulting from this, the residents of the four study communities barely have access to formal disaster-related infrastructure such as drains to facilitate the flow of floodwaters compared to the rest of Accra. This is against the common knowledge that access to certain baseline infrastructure is often required to reduce exposure to climatic hazards (Douglas et al 2008). It is therefore not surprising that the respondents in this study were found exposed to various forms of climate-related hazards as well as the related ailments.

Also important in the hazards debate is a suggested relationship between people's perceptions about hazards which are said to be often based on their actual experiences of the related events (Adger 2006; Renn et al. 1992). In this regard, Adger (2006) has argued that a determination of vulnerability can include the perspectives of those often affected, as vulnerability is uniquely experienced within the local contexts of households and communities. For Jabeen and Johnson (2013), underlying this reasoning is the role of perception on the extent to which informal dwellers may view themselves as helpless in the face of hazards. It is in recognition of the role of perception that Isunju, Orach and Kemp (2015) have analysed the socio-ecological drivers

associated with 'perceived vulnerability' in Kampala's informal settlements. This is against the knowledge that informal settlements residents are often exposed to multiple climatic-related hazards (Dodman and Satterthwaite 2008). This study, therefore, assessed vulnerability in the wider context of the social and climate change-related hazards in the study communities.

Notably, a number of social contextual factors influence the study respondents' perceptions about the hazard risks they face, and their likelihood to perceive themselves as vulnerable. Residents of the two squatter communities were more anxious about their exposure to hazards influencing their perception of the same. This is indicated by the statistical significance of threat of eviction as the main factor associated with their perceived vulnerability. A threat of eviction tends to increase the level of worry for squatters discouraging them from investing in their dwellings to minimise exposure to climate change-related hazards (Roy, Hulme & Jahan 2013).

Therefore, the results from this study also show differences in perceived vulnerability as influenced by the different property (land) rights and threats of evictions within and between informal communities. Underlying this challenge of 'threats of eviction' is the prevalent plural land management system and urban planning regime found in many developing countries. In this study, the framing of the legitimacy of the residents of the study settlements by the city planning department was guided by the nature of their land ownership arrangements. This has been found to have influenced the planning process and the overall availability of communal services, in the study communities. While the two communities of Old Fadama and Ga-Nshonaa are declared as squatters by the Accra City Authority, the other two [Gbegbeyise and Adedenpko] are viewed as traditional impoverished communities. It was therefore not surprising that higher access to state-supported urban services was found in Adedenpko and Gbegbeyise, in contrast to little to none in Old Fadama and Ga-Nshonaa. This supports Watson's (2009) argument that state authorities in developing countries often determine urban dwellers' citizenship rights based on the nature of their land ownership rights. Overall, this discriminatory process in service provision has differentially exposed the respondents to hazards in many informal settlements (Adelekan 2010; Ajibade & McBean 2014; Pelling 1997; Zoleta-Nantes 2000).

Therefore, the central theme of this thesis is a contribution to the theory of social vulnerability to hazards highlighting the role of perception. This study analysed the drivers associated with

respondents' perceived vulnerability within their wider socio-ecological contexts including climate change. It follows after Isunju, Orach & Kemp (2015) who analysed the factors associated with the 'perceived vulnerability' in informal settlements in Kampala (Uganda) in the context of flooding. Thus the thesis supports an extension of the known theory of socially differentiated vulnerability to hazards as determined by a suite of socio-economic, political and institutional contextual factors. However, the thesis also strongly emphasises the need for vulnerability scholars to pay attention to the role of perceptions in determining the most significant associated factors.

8.4.2 Knowledge, Power and Preparedness to Hazards

The relationship between perception as well as knowledge in responding to risks has been studied by several scholars (Jabeen and Johnson 2013; Messner and Meyer 2005). It is often argued that people's perception of a particular risk invariably influences their response to the same (Messner and Meyer 2005). Also, this perception or actual knowledge about the severity and impacts of risks tend to be influenced by past events (Grothman and Patt 2005). In this present study, most respondents reported changes in temperature, rainfall patterns, floods and storms as in tandem with changes in their environment. Also, most respondents were found to be aware of climate change. This is against the backdrop that access to information for early warning is critical to minimising vulnerability to climatic hazards (Dodman, Bicknell & Satterthwaite 2012; Moser & Satterthwaite 2010).

Moreover, the relationship between household's perception and knowledge about hazards and their location has received the attention of various scholars (Cutter et al. 2008; Grothman and Patt 2005; Wamsler & Brink (2014). Wamsler & Brink (2014) argue that educational levels of households and their geographical location tend to be associated with their knowledge and capacity to respond to climate change. Similarly, for Cutter et al. (2008) people's perceptions and knowledge about environmental risks do not only differ according to the social context but also according to their location. The finding from this study portraying an association between the geographical location and levels of education of the respondents does confirm this existing knowledge about hazards risk perception and geographic location.

Furthermore, an interesting point has often been raised about the role 'actors' play in the development of early warning on hazards in urban areas (Hilhorst 2013; Zhang et al. 2014). It is said that an efficient pre-warning information dissemination system for public emergency

responses often depends on good stakeholder engagements (Zhang et al. 2014). In this study, the sources of early warning for climate change-related hazards in this study which included television, radio, local groups, as well as traditional monitoring systems. This is understood in the context of the sub-optimal performance of state disaster management institutions in the study communities. In addition, state departments responsible for planning a response to hazards were engaged in disagreements with communities about the causes of flooding. Underlying this condition was the framing of the communities' legitimacy around tenure security. Residents of the various study communities are therefore worried about both climate-related and social risk of tenure security resulting from their location in such communities. Therefore, community members mainly relied on their local knowledge about past events and on information from communal sources. Such local knowledge of storm routes, wind patterns, cloud formations, or animal behaviour, have been found to often enable residents of settlements reduce their risk from hazards (Douglas et al. 2008; Wamsler & Brink 2014). It is noteworthy from this study the importance of assessing vulnerability including the contested views within the prevalent power relations between informal communities and state officials.

Taken together, the findings emphasise the suggested importance for adaptation scholars to pay attention to the differentiated socio-economic contexts of households, relative to the packaging and delivery of hazard reduction information (Kirchhoff, Lemos & Dessai 2013; Lemos et al. 2002). However, this study adds the importance of understanding power dynamics between community members and city authorities in the framing of community vulnerability to hazards, often overlooked in the literature.

8.4.3 Differential Adaptive Capacity, Agency and Response to Hazards

It has generally been argued that urban dwellers have differentiated capacities through which they respond to different vulnerabilities (Blaikie et al. 2014; Pelling & Wisner 2012). To other adaptation scholars, the nature of households' response to hazards is directly correlated with their tenure security (Cissé & Sèye 2015; Roy, Hulme & Jahan 2013; Wamsler 2007; Wamsler & Brink 2014). Therefore, scholars assert that the extent to which residents perceive their tenure tends to influence their adaptive responses – residents with a higher perception of tenure security would most likely carry out structural responses. In this study, by squatting on public land, residents of Old Fadama and Ga-Nshonaa have less security of tenure since the land is owned by the government. By contrast, residents of Gbegbeyise and Adedenpko have more security of tenure over their land.

Notably, these differences in tenure status of the communities were associated with the respondents' capacity to respond to hazards in the four study communities. In this study, both household and communal adaptive responses to hazards were adopted. The responses were mainly a range of structural measures to their dwellings and in few cases, communal infrastructure; but few non-structural measures were also adopted. Structural measures adopted were associated with the household tenancy, income and their perception of 'threats of eviction' over land. Tenants were less likely to take adaptive action than landlords given their limited property rights. By contrast, landlords who have superior property rights more easily took adaptation decisions. This is against the backdrop that, tenancy agreements in informal settlements in Accra often require tenants to seek the consent of landlords before any housing maintenance works are undertaken (Arku, Luginaah & Mkandawire 2012).

Moreover, scholars show that economic diversification does not only help the urban poor to be less affected during disasters but also enables them to recover more from the same (Wamsler & Brink 2014). Nevertheless, according to Roy, Hulme, and Jahan (2013) property owners tend to be more able to conduct multiple livelihood activities to respond to their contextual vulnerabilities in informal settlements. However, in this study, economic diversification was associated with the household size of the respondents, but not associated with their tenancy status. The finding, therefore, further supports the often suggested view that adaptation scholars should take into cognisance the differentiated adaptive capacities of urban dwellers.

Another relationship this study highlights is that between human agency and adaptive behaviour. It is argued that sustainable adaptation requires equitable responses to climate change-related and other hazards. This is understood that a lack of equity will make such policies themselves aggravate vulnerability for the marginalised (Pelling & Wisner 2012). Yet, the main policy initiatives – the National Adaptation Strategy and Ghana Climate Change Policy – have remained deficient in terms of their focus on informal settlements' vulnerabilities. This has translated into a lack of focus on the vulnerabilities of informal settlements in the Accra' medium-term development plans.

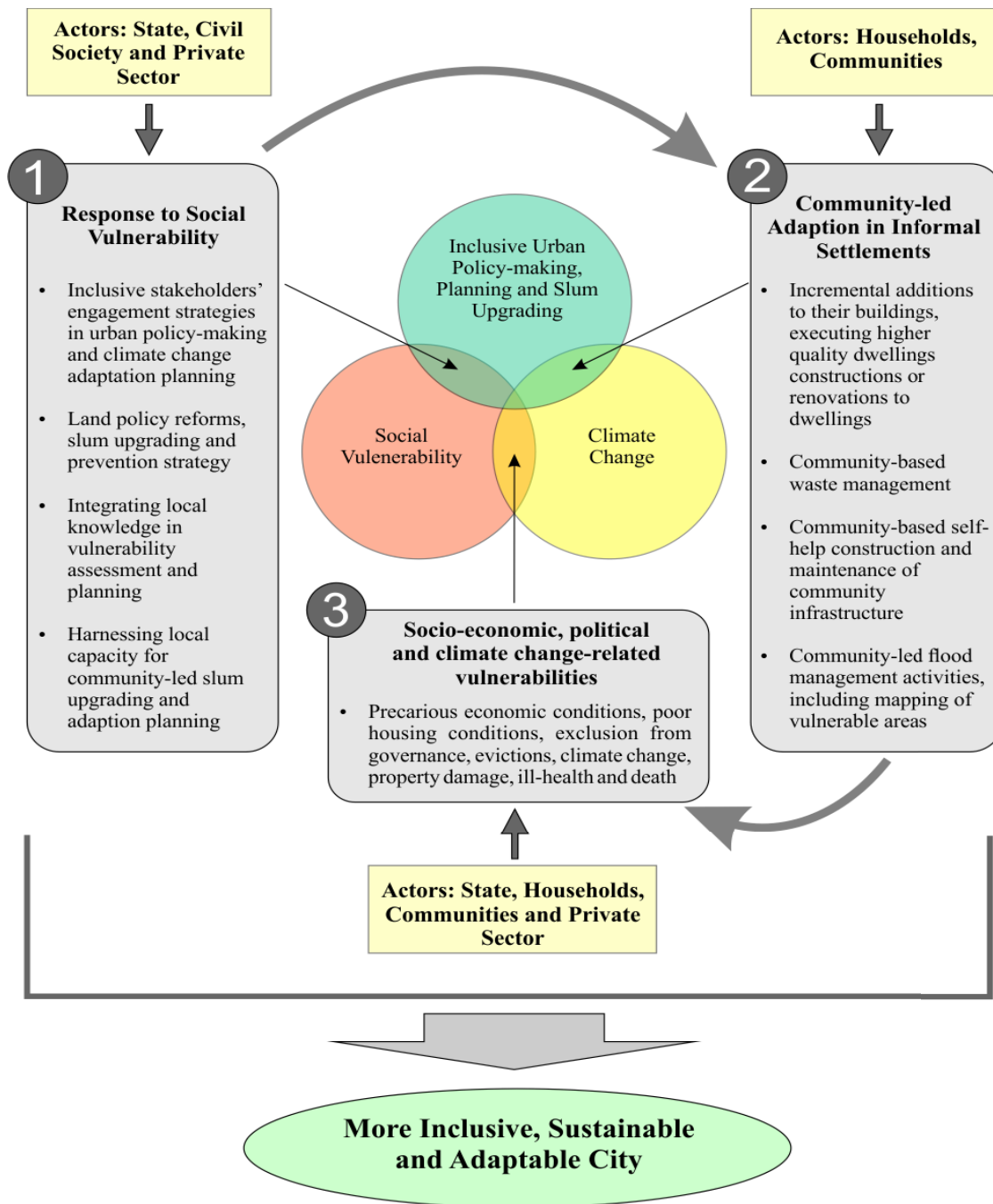
Also, the few planned hazard response interventions in the plan are focused on structural measures as in many urban areas of developing countries (Chatterjee 2010; Zoleta-Nantes 2000). Expressly, the state's response was limited to the distribution of short-term relief items after flooding and storms, accompanied by forced eviction of residents of informal settlements.

Respondents in Adedenkpo, Gbegbeyise and Old Fadama mostly organised themselves through Community-based Organisations such as Landlords Associations, to respond to climate change-related hazard events. Nevertheless, the finding that migrants in Adedenkpo similar to those in Ga-Nshonaa were often excluded from communal activities, together meant that the communal activities have been less effective and beneficial to migrants. Therefore both individual and collective agencies are called on in responding to hazards in the study communities. Overall, findings of this study show that residents of the four study communities have built social capital, innovations and have applied both their latent and actual capacities in responding to general hazards. However, this study also shows that the residents of informal settlements are not a homogenous group of defeated, marginalised and ‘passive victims’ of climatic hazards. They have and do exercise their individual and collective agencies in responding to their multiple vulnerabilities. Therefore adaptation scholars should narrow the gap on the binaries between structuralist and agency-based framings of people’s vulnerabilities and adaptation behaviours in order to capture these nuances.

8.5 Implications for Policy-formulation and Climate Change Adaptation Planning

As has been noted by Chatterjee (2010), this thesis also begun by noting that the major challenge to local authorities in their efforts to respond to climate change-related hazards is how to address long-term goals of sustainable development in their cities. The findings of the thesis’ three research questions, therefore offer insights for urban policy-making and climate change adaption planning practice towards a more sustainable and adaptable Accra and similar contexts. The implications depicted in Figure 8.1 are discussed in this section.

Figure 8.1: A framework for Urban Policy-making and Climate Change Adaptation Planning Practice



Source: Author's construct

8.5.1 Inclusive Planning and Participatory Slum Upgrading Towards Land Tenure and Vulnerability Management

Findings of this thesis' first main research question, have implications for urban land policy-making and climate change adaptation planning in Accra and similar contexts. Specifically, this thesis has revealed that while socio-economic, political and institutional factors drive the vulnerability of residents of informal settlements to hazards, key among them were tenancy status, nature of incomes, tenure security and the consequent 'threats of eviction'. However, the single most significant factor found was their 'threats of eviction' over their land. Related to this finding is the finding that, the city authorities in Accra also framed the legitimacy of residents around the legality of their land tenure. It has also been reported that city authorities' engagement with the study communities has influenced the nature of access to public infrastructure in the communities. However, scholarly work has shown that residents of informal settlements who have improved tenure security tend to be more motivated to improve their dwellings, which assist them in responding to climate change-related and other vulnerabilities (Roy, Hulme & Jahan 2013).

Responding to the vulnerability related to tenure insecurity of the respondents in this study, therefore, has a number of implications for both policy-making and planning practice in Accra and similar contexts. First, in terms of urban policy-making, there is the need for a more coordinated integrated urban policy frameworks in Ghana, towards addressing the peculiar needs for housing and access to land for residents of informal settlements. This may be done through a review of the current national urban policy and housing policy frameworks. This will help in planning more practically implementable activities that are matched up with the needed resources in the form of a policy-action plan. A practical starting point for this will be to revise, update and complete the Draft National Slum Upgrading and Prevention Strategy that was prepared in 2015 but has been abandoned since then.

The details of this potential policy/strategy review will require innovations. For instance, this will require a consideration of the fact that residents of informal settlements have lower-incomes, tend to require smaller plot sizes and are less able to meet the documentation requirements for developing their buildings. Moreover, since administrative bottlenecks and alleged corruption by state officials have been reported to characterise the current land management system in Ghana, an immediate strategy could be through the provision of a more

flexible system of tenure security to residents of informal settlements. This may require that residents of informal settlements are not required to comply with all the detailed land title registration requirements that presently obtain in the land administration system in Accra. Achieving this goal may be through recognition of the existing and emerging social institutions (the informal norms and regulatory processes) that currently constitute land management practices in informal settlements, as part of the land administration system at the local level.

Furthermore, given that Ghana's economy has been liberalised since the early 1980s, another way for addressing the question of access to land, and 'threats of eviction' is "*to examine how the informal land markets operate for the poor and how the market conditions can be improved upon*" (p.8) as has been proposed by Roy, Hulme and Jahan (2013) in Bangladesh. This brings to the fore the increasing pressure posed by developers of commercial properties in Accra when the low-income urban land market is entirely informal (Arku 2009). While a possible regularisation of this market will take considerable time and effort, a response to the challenge of access to land and housing, cannot overlook the need to properly understand the land market and act within its boundaries.

A more long-term solution to address the land and housing access challenge in Accra is to restructure the urban land administration system in Ghana. Earlier efforts by the Government of Ghana (GoG) in 2003 through the Land Administration Project (LAP) had an objective '*to develop a sustainable and a well-functioning land administration system that is fair, efficient, cost-effective, decentralised and that enhances land security*' (World Bank 2013, p.3). However, after over a decade of implementation of LAP, the only main achievement has been the merger of the major land sector agencies, resulting in the amalgamated National Lands Commission (World Bank 2013). The merger of these agencies, although important, remains largely administrative, making the state more dominant in the land management process, without much change in access to land for the urban poor.

A review of the progress made by LAP indicates challenges that include a continuous contestation between the state and customary landowners. The attempts to formalise the management processes have threatened the powers of traditional leaders to freely allocate land and receive rents (World Bank 2013, p.3). This is also against the background that, the superimposition of state land institutions on traditional land institutions threatens to stifle the

evolution of informal land administration, while the state has not shown an ability to administer urban land any better than the traditional system (World Bank 2013). Therefore, in spite of LAP, the challenges in the land management processes in Accra still include unclear boundaries of customary lands, alleged corruption, and cumbersome registration procedures (World Bank 2013). This then requires practice-based solutions in urban planning practice in Accra.

However, as noted by the United Nations, “*conventional approaches to land use planning and implementation have failed*” in addressing disaster vulnerability among the urban poor in developing countries (UNISDR 2004, p15). It is therefore unsurprising that, international development agencies have tended to emphasise the need for more inclusive urban planning practices that will better respond to the needs of informal settlements (Amoako & Inkoom 2018; UN-HABITAT 2003, 2009). Consistent with this call, the current guidelines for planning in Accra require the city authorities to adopt a participatory planning process. This will imply that all stakeholders’ groupings are involved in the planning and delivery for social amenities in the city (as discussed in Chapter 2). There is, therefore, the need for planning practitioners in Accra and similar contexts, to re-examine their stakeholders’ engagement strategies and processes. This may imply the adoption of more inclusive and participatory techniques that de-emphasise the absolute importance of tenure security in stakeholders’ mobilisation.

Adoption of participatory slum upgrading and prevention strategy will also require the state’s recognition of informal, and indigenous land ownership and land use systems, as dominant phenomena in the urbanisation processes in the city. This will, therefore, require encouraging the active participation of traditional landowners and community-based organisations in informal settlements in the planning process. Moreover, by adopting more participatory urban planning techniques, the interests of traditional landowners can be reassured, encouraging them to more easily negotiate safer lands for the possible resettlement of informal settlements in hazardous locations. Doing so will imply a paradigm shift from viewing residents of informal settlements, as ‘the problem’, to being ‘part of the solution’ for addressing climate change-related vulnerabilities in cities of developing countries. Moreover, such a paradigm shift in planning practice can potentially transform the present antagonistic relationship between city authorities and residents of informal settlements for improving living conditions in their communities.

8.5.2 Integrating Local Knowledge in Climate Change Vulnerability Management

The findings of this study on knowledge of climate change also have practice implications for the management of climate change-related vulnerability in Accra and similar contexts. As noted by Cannon (2000), state and local government disaster management institutions often define climate change-related problems in their terms upon which they propose "*solutions that are defined in terms of what is possible rather than what is needed*" by the affected communities (p.15). It has also been argued that local knowledge of climate change is often not included in vulnerability assessments to climate change-related hazards in developing countries although the institutional capacity for disaster response is often weak (Douglas et al. 2008; Zoleta-Nantes 2000). Scott (1988) argues that the exclusion of informal knowledge by state officials is often due to the city authorities' interest in only standardised and administratively quantifiable processes.

However, it was found in this study that, households in the four informal settlements have knowledge of climate change-related factors, including knowledge of the nature and causes of climate change. While some residents have developed an elaborate informal monitoring system for climate change-related variables, the formal knowledge system has been mainly perceived as not performing optimally in deploying early warning for disaster response.

From the thesis' findings, two important entry points could be considered in the design of integrated climate change-related vulnerability management plans for Accra and similar contexts. First relates to the integration of informal knowledge of climate change in the local adaptation policy frameworks, such as in the Medium Term Development Plan of the AMA. This will work towards the development and subsequent implementation of climate change communication strategies, to target different cohorts of residents of informal settlements to address their diverse information needs and concerns.

The second implication relates to climate change vulnerability assessments for disaster planning. This will involve integrating local knowledge in defining the patterns and distribution of vulnerability to climate change-related phenomena in informal settlements. Doing so will enable planners to determine uncertainties about short- and long-term climate effects in order to integrate the appropriate risk management mechanisms that affect the urban poor into municipal adaptation plans. By so doing, residents of informal settlements will be viewed both

as producers and consumers of such information. Overall, integrating residents of informal settlements into climate change vulnerability assessments and adaptation planning has the potential to further reduce the present level of mistrust between state officials and residents of informal settlements. Since the involvement of informal settlements will likely promote their ownership of the adaptation process, doing so likely advance the goal for sustainable adaptation to climate change in the city.

8.5.3 Harnessing Local Capacities in Informal Settlements for Responding to Climate Change and Social Vulnerabilities

The findings of this study on the third research question, do have implications for climate change adaptation and general planning in Accra and similar cities. It was found in this study, that households' capacities are differentiated according to their socio-economic and political characteristics such as religion, employment, and gender, similar to findings of other studies (Braun & Abheuer 2011; Chatterjee 2010; Zoleta-Nantes 2000). Added to this is the prevalent support network, which includes community-based non-state actors and their alliances with external institutions. This was found to assist in creating collective agencies through which respondents responded to their contextual vulnerabilities and climate-related vulnerabilities.

Nevertheless, adaptation to climate change has remained a relatively new concern for much local government planning departments in developing countries (UN-HABITAT 2003; 2009). This means that state officials often engage with climate change through spontaneous responses triggered by urgent climate events usually viewed as natural disasters (Leal Filho et al. 2018). Moreover, cities in developing countries have been shown to have limited financial and technical capacities to adequately respond to the vulnerabilities of all their residents (UN-HABITAT 2003; 2009). This brings to the fore the potential for harnessing both the latent and actual capacities of residents of informal settlements as part of the participatory slum upgrading and inclusive planning processes in Accra.

Harnessing the differentiated capacities of households and community-based groups in response to their vulnerabilities in Accra, therefore, has a number of planning implications. Firstly, climate-related hazards can and do interfere with the ability of households to sustain livelihoods, and can manifest in the destruction of a wide range of assets that households rely upon to maintain their livelihoods in slums (Gasper, Blohm & Ruth 2011), as was found in this

study. Added to the climate-induced livelihood vulnerabilities of the respondents, a major constraint they faced was the ‘threats of eviction and harassment’. It has also been found in this study that, poor housing and economic conditions of the residents are contributing to their vulnerability to environmental hazards.

A response to these vulnerabilities may require state authorities to recognise the importance of informal livelihoods and their relation with informal settlements. Recognising and regularising the economic activities of the residents of informal settlements have the potential to improve relations between informal economy workers and state officials and to improve household incomes. Moreover, the important role of urban infrastructure in reducing individual’s vulnerability to climate extremes is equally widely recognised in the literature on adaptation (Dodman, Bicknell & Satterthwaite 2012; Moser & Satterthwaite 2010; Roy et al. 2016). By regularising the informal sector activities, city authorities also stand the chance of improving on their revenue generation, to finance the needed infrastructure in informal settlements. Doing so may aid in the reduction of the contextual vulnerability of informal settlements to climate change-related hazards.

The second practice implication of the studies’ findings relates to a community-led upgrade of informal settlements. Alston (2013), for instance, highlights inequality and access to infrastructure, as the factors that underlie the household’s ability to reduce their vulnerability to climate change-related hazards. In this study, the vulnerability of the respondents was found to be associated with their building dwellings in hazardous places such as close to water bodies, as well as constructing their dwellings with poor quality building materials. A response to these vulnerabilities will require city authorities to enhance the capacities of the households to properly adopt building sites and appropriate building materials, to reduce their vulnerability to climate change-related hazards. For a successful community-led slum upgrading to respond to climate change-related vulnerability in Accra, capacity building and technical advisory services may be required to support household-led processes. Moreover, by supporting households in responding to climate change-related vulnerabilities, such households will be able to make incremental additions to their buildings, including strengthening and making them resilient to climate-related events.

Furthermore, community upgrading schemes that provide training in construction skills sometimes lead to skills transfer, thereby increasing the pool of semi-skilled artisans in such poor urban communities (Boonyabanha 2009; Imparato & Ruster 2003; Otiso 2003). It should be noted, however that, while training too many artisans may affect their market and fees in their communities, a well-managed skills training programme that is built on a skills-gap assessment, will ensure a balance in the supply and demand for such artisans. If done well, such artisans can then assist in executing higher quality dwelling constructions/renovations, in supporting adaptation efforts at the community and household levels.

The second point of intervention for local governments is by ensuring that land use planning and the development of buildings and infrastructure take into account climate change-related risks. For instance, ignorance about building regulation is a major cause of vulnerability of the residents to climate change-related hazards, as has been shown in the survey results. This undoubtedly poses several challenges, as it requires changes in the planning regulatory frameworks to not only prevent further development in high-risk areas but also to reduce their vulnerabilities. Doing so will require careful enforcement of building and zoning regulations, including the appropriate siting of dwellings and application of appropriate construction methods/materials in informal communities. Also, it will be important for the state to improve the provision of communal infrastructure in informal settlements, in ways that do not impose additional costs on the residents.

Beyond harnessing households' capacities for slum upgrading, city planners may also harness the collective communal capacities available in the settlements for responding to the general developmental needs and climate change-related hazards. For instance, community-based waste management and self-help construction of community infrastructure can be implemented through mobilising collective efforts, by city and local authorities. Similarly, community-led flood management activities such as community mapping of vulnerable areas, selections of safe locations may help develop a city-wide climate-risks vulnerability profile. It must, however, be noted that households' and communities' capacities and initiatives cannot be explored where city authorities constantly threaten residents of informal settlements with forced eviction for institutional flood adaptive responses, as found in this study. It will equally be a challenge to harness community capacities for responding to climate change-related vulnerabilities if residents of informal settlements display resentment towards state officials.

This then further supports the recommendation for adopting more inclusive planning techniques, to promote effective stakeholder participation in the planning process.

Finally, an intervention for reducing exposure of the residents of informal settlements while supporting adaptation planning in Accra to climate change-related hazards is involuntary resettlement of some communities/settlements. Undoubtedly, relocation tends to detach households from their cultural heritage, the source of livelihoods, and an overall sense of place and belonging. However, in some cases where informal settlements develop in high risks-zones of impact to the whole city, their relocation may be warranted to avert future heavy human and economic losses. A decision to relocate residents of such a settlement may involve participatory risk-mapping, allowing the residents to become aware of their situation. Also, the decision to relocate such communities may require the planning of an alternative site, taking into consideration the livelihood activities of the communities. Overall, such action will complement measures that have been earlier recommended to build the capacities of residents of informal settlements. Doing so will allow the residents to lead the adaptation process towards a more inclusive, equitable and sustainable adaptable city.

The findings of this study also have implications for international disaster management practice. As suggested by Comfort et al. (1999), direct and active involvement of urban dwellers who live in hazardous locations, is often emphasised in vulnerability assessments. However, the dominant approach in disaster response tends to focus on structural measures, as well as the occasional distribution of relief items after the occurrence of hazards (Chatterjee 2010). By adopting more participatory techniques that involve those often affected in cities, disaster management practitioners will be able to improve upon their processes towards more sustainable outcomes in such cities.

8.6 Areas of Possible Future Research

The study then makes a number of suggestions of areas for potential future research on vulnerability and adaptive responses to climate change in developing countries. In relation to the thesis question one, this study examined the drivers of vulnerability for households to hazards. Yet, the analysis did not thoroughly examine the intra-household socio-economic dynamics, such as the nature of the breakdown of assets owned by the different household members and relation with their vulnerability to climate change. Future researchers may consider further examining the intra-households socio-economic and political dynamics and

the relationships with the factors that drive a household's vulnerability to multiple climate change-related hazards.

The second area of potential future research is on the knowledge of climate change and the development of early warning on hazards in relation to question two of this thesis. For instance, the study found synergies between local knowledge of climate change among majority respondents with scientific data, for most of the climate change-related phenomena. This study thus recommended the need to integrate local knowledge with the scientific knowledge of climate change, in determining local vulnerability to climate change in Accra. Moreover, integration of local knowledge into formal early warning systems has the potential to improve lead-time for sustainably responding to climate-related adverse events in cities. However, the question of which aspects of informal knowledge can be integrated with which aspects of scientific knowledge at a practicable scale (whether at community, city and national level) remains unexamined. Future researchers may thus seek to examine the scale at which informal and formal knowledge of climate change can be practicably integrated into Accra.

Further, future scholars may also contribute to the discourse of adaptive capacity and adaptation in informal settlements relative to the thesis question three. Specifically, it has been found in this study that, no respondent household reported the use of insurance as part of the adaptation funding and/or support arrangements. However, Gencer (2003) suggests that insurance could play a major role in adaptation funding for flooding hazards. Future researchers may then examine the insurance market for climate change adaptation among the urban poor. Such examination may include analyses of both the demand and supply side factors and the potential for up-scaling such products to support adaptation to climate change in developing countries.

Finally, the question of access to land in Accra, similar to other cities of developing countries, was found as accounting for 'threats of eviction' as a key determinant of respondents' vulnerability in this study. Yet, in Ghana, the low-income urban land market is entirely informal (Arku 2009). This study has recommended a number of possible measures to respond to the threat of eviction among residents of informal settlements. However, it remains quite unclear as to what practical steps can be taken to improve upon access to land for residents of informal settlements given the current increasing pressure on land for commercial development

purposes in Accra. Future researchers may seek to examine the dynamics of the urban land market, with a deeper focus on the informal land market. This may shed light on the inherent constraints and prospects for influencing adaptation planning for residents of informal settlements to climate change-related hazards. Related to this, could be an examination of why previous land reforms have had minimal success in responding to the challenges of informal urbanisation.

Furthermore, poor communication between residents of informal settlements and city planning staff has been found in this study. The study, therefore, recommended the adoption of more effective inclusive techniques to include informal settlements' residents in the planning process in the city. However, the exact techniques to adopt and the incentives required to make these successful remain unknown. Future scholarship may examine these techniques, including determining the incentives that are required to make them successful in cities.

Overall, future studies in cities of developing countries may adapt and fine-tune the instruments, applied in this study for assessing 'perceived vulnerability' and adaptive responses in informal settlements. Such a study could also be longitudinal, given the limitations of this cross-sectional study to elucidate historical trends that may have added more meaning to the findings. This may contribute to both urban policy-making and climate change adaptation planning practice in different contexts.

8.7 Contribution of the Thesis

This thesis contributes to theory, practice, and praxis. In terms of theory, the thesis contributes to the theory and discourse of social vulnerability and adaptive capacity to climate change-related hazards in the wider debate on sustainable development in cities of developing countries. First, current literature that sheds light on the drivers of the vulnerability of residents of informal settlements to climate change has been situated within the theoretical lenses of political ecology (Adelekan 2010; Ajibade & McBean 2014; Pelling 1997; Zoleta-Nantes 2000). The narrative of these studies has often focused on how residents of informal urban settlements become vulnerable to flood hazards through historical and contemporary socio-economic and political processes. The theoretical frameworks and the ontological positions of these studies have often presented residents of informal settlements as 'passive victims' of these hazards. Recommendations made by these scholars tend to address the wide range of socio-economic and political factors that influence peoples' vulnerability to flooding hazards.

In so doing, decision-makers have tended to find it challenging in identifying the priority factors in adaptation policy-making, planning and intervention.

However, the vulnerability of residents of informal settlements to hazards is a contextual experience. This depends on the peculiar conditions of the household (Adger 2004), as has been shown in the study conducted by Isunju, Orach and Kemp (2015) in Kampala (Uganda). This thesis has extended this framing of the drivers of vulnerability to wider climate change-related hazards, as a contextual experience, by including the perception of the residents of informal settlements. The study shows that while socio-economic, political and institutional factors drive the ‘perceived vulnerability’ of residents of informal settlements to climate change-related hazards, the physical exposure of the residents to climate change-related hazards was not a key factor. Rather, their perceived and real ‘threats of eviction’ over their land was the single most significant driver associated with this vulnerability. By extending this methodological approach in determining the drivers of the vulnerability to multiple climate change-related hazards, this thesis thus makes an original contribution to the social vulnerability and hazards discourse.

Another theoretical contribution of the thesis is to adaptation discourse. Generally, scholarly work on adaptive capacity and responses to climate change in informal settlements have often taken a predominantly qualitative outlook. Scholars that adopt quantitative approaches such as Abeka (2014) and Chatterjee (2010) have tended to correlate household socio-economic characteristics with their adaptive responses to flooding hazards. Furthermore this scholarship tends to treat adaptation solely from the structuralist perspective. In so doing they overlook the role of human agency in the framing of slum dwellers’ adaptive responses to hazards. The lack of attention of studies in determining the factors associated with the adaptive responses of residents of informal settlements to the multiple climate-related hazards they face does not support efforts at local adaptation policy-making, planning and response in developing countries. Critical information on household characteristics is often omitted in the policy-making and planning processes in such cities.

This study examined the question of “who adapts to what and why in the context of climate change-related hazards in informal settlements?” The findings show that residents of informal settlements often adopt multiple economic activities as well as transforming climatic hazards to enhance their economic status and reduce their contextual vulnerability to the same. The

residents also adopt hazard-specific responses to climatic hazards in their built environments; engaging in climate-proofing activities, while others temporarily relocate, and others ‘do nothing’. Respondents also reported to often mobilise themselves and undertake communal activities to respond to climate change-related hazards, but also improve their tenure insecurity. In this study, key factors of tenancy status, threats of eviction, and household incomes were found to be associated with the adaptive decisions by households to multiple climate-related hazards of flooding, storms, and excessive heat. By analysing the adaptive capacity of respondents and its influencing factors to households’ adaptive responses to multiple climate change-related hazards, this thesis contributes to the adaptive capacity discourse. Overall, the study thus makes a contribution to theory by extending the discourse of social vulnerability and adaptive capacity related to informal urbanisation, climate change adaptation and the discourse of sustainable urban development.

Furthermore, by highlighting the relevance of the findings of this thesis for urban policy-making and adaptation planning practice, this thesis also contributes to urban policy-making and development planning practice in Accra. Finally, the findings of this study have the potential to equip residents of informal settlements and non-state actors to continue with their policy advocacy efforts. Thus, the thesis contributes to praxis.

8.8 Conclusion

Accra, similar to many African cities, experiences informal urbanisation, the challenges of which are exacerbated by the global climate crises for residents of informal settlements. Undoubtedly, future climate change-related hazards will exert further pressure on residents of informal settlements in Accra and other African cities. Understanding the existing vulnerabilities and adaptive responses of residents of informal settlements have been highlighted by different authors as necessary for adopting initiatives that build resilience at household and community levels in cities. Yet, little is known and documented of the vulnerability and adaptive practices of residents of informal settlements to the socio-ecological hazards they face in developing countries (Jabeen, Johnson & Allen 2010).

This study examined the social, economic, political and institutional factors that differentially influence vulnerabilities for residents of four informal settlements to climate change-related

hazards in Accra, Ghana. The findings are contextual and experienced and perceived by the affected households in the four informal settlements. In brief, although the residents of these four communities are exposed to several climate-related and non-climatic hazards, the principal driver of their vulnerability is the nature of their tenure security. The physical exposure of the residents to climatic hazards were not key drivers of their vulnerability. However, residents had extensive knowledge of climate change and had the potential for influencing climate change vulnerability assessment and adaptation planning in the city. Added to this is the differentiated ‘capacity to respond’ to the varied vulnerabilities, including climate change, among residents of the four informal settlements in this study.

Results of this study show the nature and types of coping strategies that are used by the residents of the four case study communities as related to their socio-economic and political characteristics. These findings have been shown to have implications for both urban policy-making and development planning practice in Accra and similar contexts.

The thesis concludes with three major recommendations to address existing processes of marginalisation and vulnerability of residents of informal settlements to climate change-related hazards in Accra. Firstly, city managers may have to consider adopting more inclusive practices to include marginal populations in the planning and governance of the city. Secondly, city managers may incorporate the knowledge, learning and innovative networks of marginalised populations for assessing their vulnerabilities to climate change-related hazards. Finally, city managers may consider recognising and integrating the differentiated adaptive capacities in informal settlements in the implementation of participatory slum upgrading interventions. Thus, by examining an existing research problem through a new way and in a new context, this study makes an original contribution to knowledge.

9 APPENDICES

9.1 APPENDIX 1: ETHICS APPROVAL

From: Research.Ethics@uts.edu.au [<mailto:Research.Ethics@uts.edu.au>]
Sent: Friday, 3 February 2017 6:02 PM
To: Sumita Ghosh <Sumita.Ghosh@uts.edu.au>; Ishmael Adams <Ishmael.Adams@student.uts.edu.au>;
Research Ethics <research.ethics@uts.edu.au>
Subject: HREC Approval Granted - ETH16-1013

Dear Applicant

Thank you for your response to the Committee's comments for your project titled, "Adaptation to Climate Change in Coastal Urban Informal Settlements in Accra: Policies and Practices". Your response satisfactorily addresses the concerns and questions raised by the Committee who agreed that the application now meets the requirements of the NHMRC National Statement on Ethical Conduct in Human Research (2007). I am pleased to inform you that ethics approval is now granted.

Your approval number is UTS HREC REF NO. ETH16-1013.

Approval will be for five (5) years from the date of this correspondence subject to the provision of annual reports.

Your approval number must be included in all participant material and advertisements. Any advertisements on the UTS Staff Connect without an approval number will be removed.

Please note that the ethical conduct of research is an on-going process. The National Statement on Ethical Conduct in Research Involving Humans requires us to obtain a report about the progress of the research, and in particular about any changes to the research which may have ethical implications. This report form must be completed at least annually from the date of approval, and at the end of the project (if it takes more than a year). The Ethics Secretariat will contact you when it is time to complete your first report.

I also refer you to the AVCC guidelines relating to the storage of data, which require that data be kept for a minimum of 5 years after publication of research. However, in NSW, longer retention requirements are required for research on human subjects with potential long-term effects, research with long-term environmental effects, or research considered of national or international significance, importance, or controversy. If the data from this research project falls into one of these categories, contact University Records for advice on long-term retention.

You should consider this your official letter of approval. If you require a hardcopy please contact Research.Ethics@uts.edu.au.

To access this application, please follow the URLs below:

* if accessing within the UTS network: <https://rm.uts.edu.au>

* if accessing outside of UTS network: <https://vpn.uts.edu.au> , and click on " RM6 – Production " after logging in.

We value your feedback on the online ethics process. If you would like to provide feedback please go to: <http://surveys.uts.edu.au/surveys/onlineethics/index.cfm> . If you have any queries about your ethics approval, or require any amendments to your research in the future, please do not hesitate to contact Research.Ethics@uts.edu.au.

Yours sincerely,

Associate Professor Beata Bajorek
Chairperson
UTS Human Research Ethics Committee
C/- Research & Innovation Office
University of Technology, Sydney
E: Research.Ethics@uts.edu.au

9.2 APPENDIX 2: HOUSEHOLD SURVEY QUESTIONNAIRE

Household Survey Questionnaire

NB: This is to be administered to ONLY the head of the household. Informed consent is to be read out by the person administering the questionnaire.

Informed Consent

My name is I am part of a PhD research that seeks to investigate how people in informal coastal communities in Accra: **Adedenpko, Ga-Nshonaa, Gbegbeyise and Old Fadama**, respond to changes in rainfall, temperature, storms and other climate change-related occurrences. This research **Adaptation to Climate Change in Coastal Urban Informal Settlements in Accra: Policies and Practices** is being conducted by the Candidate Ishmael Adams, under the supervision of Dr Sumita Ghosh, sumita.ghosh@uts.edu.au, +61 [REDACTED], School of Built Environment, Faculty of Design and Architecture, Building 6, Level 5, Box 123, Broadway, NSW, 2007, Australia

Your household has been selected to participate in this survey. The information required for this survey covers the household's perceptions, experiences and socio-economic issues in relation to such climate change effects. This interview will take about **50** minutes of your time. Please note that although your participation will be helpful in this research, your participation is voluntary. Should you accept to participate on behalf of your household:

1. Your identity would not be disclosed in any report or publication arising from this research;
2. Please be informed that this interview may be recorded and that you can request a copy of this interview and/or transcript, as needed;
3. You are free not to answer any questions that you are not comfortable with;
4. You can withdraw from the interview at any stage without the need for a reason and any consequences; and
5. You can ask any questions to seek any needed clarifications.

Should you have any complaint about this survey, you can contact the lead researcher: Dr Sumita Ghosh, reachable through sumita.ghosh@uts.edu.au, +61 [REDACTED], School of Built Environment, Faculty of Design and Architecture, Building 6, Level 5, Box 123, Broadway, NSW, 2007, Australia, or the UTS Human Research Ethics Committee through The Research Ethics Officer (ph: +61 2 95149772, Research.Ethics@uts.edu.au).

Please, are you available and comfortable to participate in this research? Yes [] No []

HOUSEHOLD SURVEY QUESTIONNAIRE

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Questionnaire Number:

Name of Interviewer:.....Date

Telephone Number of Interviewee (if available):..... House address/or any means of identification (if possible):

Name of Community:.....

Part I: Perception, knowledge and experience of environmental changes and climate change/variability

1. What is your view on possible observed changes in the following environmental and climate-related phenomena/issues in this settlement (in terms of magnitude and/or timing/frequency)? [**Instruction:** Tick [] as appropriate].

	There have been changes/increases	There have not been changes/increases
i. Slow events:		
Temperature / excessive heat		
Coastal erosion		
Sea level rise		
Salt water intrusion/groundwater salinity		
Rainfall patterns		
ii. Sudden events:		
Flooding		
Storms (<i>rain and/or wind storms</i>)		

2. Do you perceive some (or any) relationship between any or all of such long-term environmental changes above and climate change/variability in this community and city?
a. Yes [] b. No [].
3. What do you perceive is the main cause of changes in the climate (long-term changes in weather) of this community and city?
a. Act of God [] b. Community/local level environmental pollution activities [] c. Global industrial activities [] d. Other []. Explain.....

4. What has been your main mode of transfer/source of local knowledge about climate change and variability?
 - a. Peer to peer [] b. Personal [] c. Kinship [] d. Other [] Specify.....

5. What has been the single most frequent climate change-related hazard that affects your household in this community (using the most recent one that affected you most over the last one to two years)?
 - a. Temperature and excessive heat []
 - b. Fire hazard []
 - c. Coastal Erosion []
 - d. Sea level rise []
 - e. Salt water intrusion []
 - f. Floods []
 - g. Storms []

6. What is the timing of your experience with the following climate-related events in your community and city: **(Tick as applied)**
 - a. Excessive Heat Stress: a. December-March [] b. April-August [] c. Not very sure [] d. the whole year []
 - b. Floods: a. May-October [] b. November-April [] c. Not very sure [] d. the whole year []
 - c. Storms: a. May-October [] b. November-April [] c. Not very sure [] d. The whole year [] other [], Specify
 - d. Rainfall Patterns/Timing of Rainfall: a. December-March [] b. April-August [] c. Not very sure [] d. the whole year []

7. To what extent do you perceive your household as socio-economically, politically, institutionally and ecologically (including climate change-related) vulnerable? a. Vulnerable [] b. Not Vulnerable []
Please explain your response.....

8. What do you perceive as the most important thing to your household which has been affected by the last most frequently experienced climate change-related hazard?
 - a. Health [] b. Housing [] c. Production assets [] d. Lives [] e. Livelihood activity []

9. How frequently do you fall ill in a year (averagely)? a. once [], b. twice [], c. three times [], d. More than three [], e. None []

Part II: Adaptive Responses/Practices

10. To what extent do you have knowledge of state disaster management-related institutions and their performance in this community/settlement? **[Instruction: tick X as appropriate]**

Name	Aware of and Satisfactory	Aware of and unsatisfactory	Not aware
NADMO			
Ghana Fire Service			
Meteorological Agency			

11. Is there any traditional/local way of monitoring climate change that you sometimes resort to or apply in your daily life? a. Yes .b No If yes, please mention them here.....

12. What adaptive measure is often adopted by your household against the main climatic affects that you suffered from (using the most memorable recent and significant event over the last one to two years) ?

a. Flooding: a. Took action/modify structure/climate proof b. Relocate c. Do nothing

b. Excessive heat/heat wave: a. Took action/modify structure/climate proof b. Sleep outside c. Do nothing

c. Storms (rain/windstorms): a. Took action/modify structure/climate proof b. Relocate c. Do nothing Please provide a brief explanation here.....

13. If your household has been responding to the climate-related hazards, what do you do **before, during** and **after** the events?

Climate effect and impact	Action before the impact occurs	Action during the impact	Action after impact(Reconstruction)

14. Based on respondent’s answers to question 12, did respondent take a structural mitigation/adaptive measure in response to each of the most recent and significant storm (rain/windstorm), heat wave, and flooding experienced the household in this community)? a. Yes b No . **[Instruction: tick X as appropriate].**

15. Have you received an early warning on climate-related issues from external sources (all sources excluding from friends and family), over the last 1 to 2 years? a. Yes .b No
If yes, please mention the source.....
16. What is the main source of early warning received by you over the last 1 to 2 years? a. Radio b. TV. c. Self/friends/relatives d. Community-based groups . e. Government officials
17. What has typically been your main consideration in taking an adaptive response to climate change-related hazard (this should be based on the most recent adaptive decision mentioned in question 12)? a. Finance b. Perceived effectiveness of the option c. Knowledge of climate change
18. What do you consider as the single main source of funding and/or support that was available often depended upon and applied to minimise your most important climate change-related and/or social vulnerabilities (economic or land tenure), over the past one to two years in the study communities? a. Personal/household resources/savings , b. From group/joint contribution with others c. CBO/Trade Association , d. Government/institution , e. Micro-finance institutions-MFI/local loans/Susu , f. Other (National/International NGOs, etc) Specify the form of this funding and or support.....

Part III: Associational Life and Governance

19. Do you as head of household, belong to any social group? a. Yes b. No
Please provide the details here, if yes
20. Do you feel involved in the governance of the city of Accra?
a. Yes b. No Please explain your response.....
21. Are you aware of building regulations and the development permitting process in this city?
a. Yes b. Not . Please explain your response.....

Part IV: General Household Information and Demographic Characteristics

22. Gender of respondent: a. Male b. Female
23. Age of respondent: a. 18 – 25yrs b. 26 - 35years c. 36 - 45years d. 46 - 55yrs
[] e. 56 – 60 yrs f. 61+ yrs
24. Level of education? a. Primary b. JHS c. MSLC d. SHS e. Vocational/Technical f. Tertiary g. Professional (specify)..... h. None
25. Ethnicity of household head: a. Ga b. Akan c. Ewe d. Guan
e. Gurma f. Mole-Dabgani g. Grusi h. Mande i. Other, specify

26. Please provide the names and ages of all members of your household including yourself. [**Instruction: Indicate the head of household with a tick X by the name**]

Full Name	Occupation for members aged 18 years and above	Educational Status 1 = No education 2= Pre-School 3= Primary 3=Middle 4=JHS 5= SHS 6=Voc/Tech 7= Tertiary 8= Professional 8=Other (specify)	Age 1= 0-5 yrs 2=6-10 yrs 3=11-15 yrs 4= 16-25 yrs 5=26-35 yrs 6=36-45 yrs 7=46-55 yrs 8=56-60 yrs 9=61+ yrs	Sex 1 =M 2 = F	Ethnicity 1=Ga 2=Akan 3=Ewe 4= Gurma 5= Mole-Dabgani 6= Grusi 7= Mande 10= Other, specify []

27. What is the main reason for your household's settlement in this community/ settlement?
 a. Economic/financial considerations [] b. Maintain family ties [] c. Originate from community/settlement [] d. Government intervention [], g. Other [] specify.....

28. How long have you been living in this community/settlement? a. Less than 10 years [] b. 10-20 years [] c. 21-30 years [] d. Over 30 years []

29. What is the residential tenancy status of your household? a. Landlord [] b. Renter/Tenants []

30. Do other people challenge your ownership status of your land/space (threats of eviction)? a. Yes [] b. No [] If yes to Q31, in what form?

31. What would you say best describes your source of security of tenure or form ownership/use right on this land/space in this community?
 a. Customary arrangement? [] b. Leasehold [] c. Freehold [] d. State [] g. Informal arrangement [], Other [].

Part V: Household Economy

32. What is your economic activity now?: Fishing and fish mongering [] b. Food Vending []
c. Trading [] d. Agriculture [] e. Carpentry [] f. Production and Processing [] g. Other
artisans [] h. Other services [] i. E-waste [] j. Portage (head portage and push cart) [].
Unemployed [] . Other [] (Specify).....
33. Is your economic activity the main household economic activity? a. Yes [] b. No []
If No, specify: a. Fishing and fish mongering [] b. Food Vending [] c. Trading [] d.
Agriculture [] e. Carpentry [] f. Production and Processing [] g. Other artisans [] h. Other
services [] i. E-waste [] j. Portage (head portage and push cart) []. Unemployed [] . Other []
(Specify).....
34. What was your economic activity 1-5 years ago?
a. Fishing and fish mongering [] b. Food Vending [] c. Trading [] d.
Agriculture [] e. Carpentry [] f. Production and Processing [] g. Other
artisans [] h. Other services [] i. E-waste [] j. Portage (head portage and push
cart) []. Unemployed [] . Other []
(Specify).....
35. Have you (head of household) had an alternative livelihood (minor) activity during the
last 1 to 5 years? a. Yes [] b. No []. Specify
36. If you (head of household) have had an alternative livelihood (minor) activity, was this
arrangement meant to take advantage of any climate-related hazard in this community for
minimising your economic vulnerability? a. Yes [] b. No []. Specify
37. What do you perceive as the most significant livelihood-related challenge to your
household (including the past when you worked, if currently unemployed)?
a. Prohibitive laws/regulations [] b. Access to credit [] c. Access to land/space []
d. Exploitation by employers or others [] e. Physical harassment in place of work [],
f. Lack of state legal recognition and support [], g. Low demand for wares/services [
], h. other []
38. Is your main work/economic activity officially registered or recognised and monitored by
state agencies? a. Yes [] b. No [], c. Not applicable [].
39. Are there any benefits associated with the registration status of your economic activity?
b. Yes [] b. No [], please specify.....
40. Are there any benefits associated with the registration status of your economic activity?
a. Yes [] b. No [], please specify
41. Where do you presently carry out your work or when you worked (if presently
unemployed)? a. Within community [] b. Outside community []

42. How much money did your household spend last year (approximately)? [**Instruction:** Collect estimates on weekly or bi-weekly or monthly, or any frequency convenient to household].

Description	Last year (2016) GH¢
Total:	
Amount on food:	
Amount on water:	
Amount on health:	
Amount on sanitation:	
Amount on climate proofing housing/infrastructure:	

43. How much money did your household earn (aggregation for entire household, including remittances) last year?

Last year (2016): GH¢.....

44. Do you (household head) have another source of livelihood other than the main one? a. Yes b. No . If yes, specify

If Yes, is this related to climate changes and variability in anyway a? Yes b. No . If yes, how?.....

45. Which of these do you have in your household, if any?

a. Savings . How much over the last year (2016)?.. GH¢.....

b. Credit . How much over the last year (2016)?.. GH¢.....

c. Insurance . How much over the last year (2016)?.. GH¢.....and for what adaptive response (a. economic or b. climactic hazard)?.

46. Which of the following items do you have? [**Instruction: Tick X** as applied].

<i>Items</i>	<i>Tick</i>	<i>Items</i>	<i>Tick</i>	<i>Item</i>	<i>Tick</i>
Television		Video deck		Motor Bike	
Radio		DVD		Fan	
Mobile Phone		Car		Refrigerator	
Electric Iron		Bicycle		Computer	
Cooking utensils		Box Iron			

Part VI: Housing Conditions [**Instruction: Observe and tick in question 47**]

47. What is the housing type? a. Compound House [] b. Semi-detached [] c. Detached [] d. f. temporal structure (kiosk, container, etc) [] g. Other (specify).....

48. Which is the **main** source of accessing the following services for your household?:

Water: a. Borehole/well [] b. public standpipes [] c. commercial water points []

d. Tanker delivery services [] household connection []. f. Other, specify []

Sanitation/Toilet: a. Public toilet [] b. Neighbor's toilet [] c. sea shore/open space []

d. private toilet []. e. Other, specify.....[]

Garbage Disposal: a. Drains [] b. Sea shore/bush/open [] c. Burning [] d. Dump in Skip Container [] e. personal bin [], f. informal community group []

h. Other, specify[].

49. What do you suggest could be done to improve upon the situation of people who live in informal settlements and facing challenges from climate change/variability?.....

Thank you for your time.

9.3 APPENDIX 3: FOCUS GROUP DISCUSSION GUIDES

Focus Group Discussion Guide 2—Selected from General Community

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Description: This is a guide to be used for Focus Group Discussions

Community:.....

Names of Group Members (indicate gender):.....

Date:.....

Time:.....

Areas of focus: Community background; knowledge, perception and vulnerability to climate change effects, informalisation and adaptive responses

General Background

1. Origin/beginning of the community/settlement, population and major land-use changes in history.
2. Availability of public facilities/services and numbers in the community: water, sanitation, roads, drains, schools, health facilities, electricity.
3. Ownership and management of land in the community.

Perception, knowledge and experience with climate change/variability

4. Perceptions on server weather changes (*types, intensity, frequency and timing of occurrence; increase or decrease*) in the community over the last 30 years.
5. Perception of the relation between observed long-term weather-related changes and climate change/variability in the community.
6. Ranking climate change/variability related effects in order of severity and impact.
7. Periods (historical, current) of climate change/variability related events, negative experiences and effects on households and community.
8. Perception of future climate variability/changes (magnitude, frequency, trends) over the next three decades.
9. Knowledge (*formal and informal/local*) of perceived climate change/variability effects and early warning systems/mechanisms in the community.

Adaptive capacity, adaptation and coping responses in informalisation

10. Listing (historical, current) adaptive responses to the effects of climate change/variability related events by households and community.

11. Ranking adaptive responses to climate change/variability related effects in order of importance and impact on wellbeing for households and the community.
12. Knowledge of the role of the state (institutions) in an early warning in the community for the perceived climate change effects.
13. Views on actions of the state (institutions and officials) in relation to adherence to formal planning and other regulations, policies and laws in responding to climate change-related effects: *dwelling process and climate-proofing activities, livelihood diversification activities, and land tenure security*.
14. Informal institutional changes (changes in the rules of the game) and relations with formal institutions in adaptation.
15. Climate change and variability related opportunities in livelihood activities' diversification and employment with seasonal changes.
16. Experiences/encounters with the state/institutions (**bad and good** experience) which constrain or facilitate the ability to prepare for and act on different climate change effects in households and community.
17. Knowledge about development regulations in the city
18. Performance of actors (*civil society, state and its institutions*) in mitigating the negative effects of different climate-induced effects on households and community.
19. Sharing costs and benefits of institutional adaptation (*clarify who benefits from public/institutional adaptation, if unclear*).
20. Who (gender, group of people) have the least access to adaptation resources and general wellbeing opportunities in the community and why?
21. Knowledge of state policies, regulations, programmes, laws and projects implemented, being or proposed to be implemented, and the effect on the ability to act on climate change effects.
22. Traditional/local institutional arrangements (values, taboos, norms, arrangements) that constrain and or facilitate responses to deal with the effects of climate change and general wellbeing.
23. Views on collective action, political agency and its nature, the need for collective agency in the community and how it has been applied in addressing climate change effects on housing, livelihoods and land tenure issues.
24. Main (5) community development challenges in order of priority.
25. Suggestions to improve adaptive responses, general wellbeing in successfully adapting to climate change/variability.

Thank you.

Focus Group Discussion Guide—Informal Sector Groups

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Description: This is a guide to be used for Focus Group Discussions

Community:.....

Names of Group Members:.....

Date:.....

Time:.....

Areas of focus: Informality, livelihood activities, effects of climate change/variability and adaptive experiences.

Knowledge and experience of climate change/variability

1. Views on long-term weather and related issues of this settlement (in terms of magnitude, timing and frequency of, e.g temperature, rainfall, winds, etc) over the last 30 years.
2. Views on link between long-term weather and related changes/variations, and **climate variability and change**.
3. Ranking climate change/variability effects on their livelihoods in order of severity and impact.
4. Knowledge (*formal and informal/local*) of perceived climate change/variability effects and early warning systems/mechanisms in the community.
5. Views on institutions and early warning on climate-related problems.

Informality, adaptive capacity and responses

6. Experiences in taking advantage of **climate change/variability effects** in livelihood activities.
7. Views on role of the state, private sector and civil society in adaptation options **over the past 1-5 years**.
8. Views on **level of their legal recognition and involvement of the state/government institutions** in livelihood adaptive responses (facilitating or constraining) to the effects of climate change/variability.
9. Work-related challenges among you and with large formal institutions and the effect on adaptive capacity.
10. Views on public adaptation in relation to livelihoods; successes and challenges.

11. Views on social norms (local norms, code of conduct, patronage) and effects on the ability to respond to effects of climate change and variability in community.
12. Views on the collective agency, social capital and the value to climate variability and change effects.
13. Knowledge of state policies, legislation, regulations and administrative norms and procedures and the effect on livelihoods in coping and adapting to the effects of climate change/variability effects.
14. **Challenges** and **benefits** in relation to the registration of livelihoods, recognition and monitoring by state agencies.
15. Suggestions to improve the situation of people who live in informal coastal settlements facing challenges from climate change/variability in Accra, (including your community).

Thank you.

9.4 APPENDIX 4: KEY INFORMANT INTERVIEW GUIDES

A.National Disaster Management Organisation (NADMO)

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Views and evidence on climate change/variability effects in informal settlements in Accra.

1. What has been the nature of long-term weather and related issues in Accra (in terms of magnitude, timing and frequency of, e.g. temperature, rainfall, winds, etc) over the last 30 years?.....
1. What is your technical opinion or perception on a linkage between current environmental changes and climate change climate variability and change in Accra? Please provide a brief explanation of your position on climate and variability.
2. What has been the nature of climate change/variability related disasters in Accra (if any) over the last at least 20 years?
3. How does climate change/variability affect the people of Accra?
4. How will you describe the frequency and intensity (in terms of impact) of climate change-related disasters in Accra over the last 10-20 years?
5. Please provide me data on the numbers and fatalities over at least the last 10-20 years.
6. How do you perceive future climate-related disasters in Accra?
7. In your technical opinion, what factors account for flooding in Accra, especially in informal/poor communities along the coast?.....
8. How do you serve the people of Accra facing flooding, and other climate-related disasters?
9. How do you serve informal communities in Accra, facing flooding, and other climate related disasters?.....
10. What changes have you been making in your operations in response to the changes and in climate related disasters?.....
11. What role does your department play in early warning to the residents of Accra in relation to disasters?
12. Which institutions do you collaborate with in your work in Accra, and how?
13. Does your department face any challenges that affect your mandate, especially in working with other institutions and communities? Please briefly explain.....
14. What do you see as the way forward for residents of informal settlements living with climate change/variability related effects/disasters in Accra?.....

Thank you

B. Non-governmental and Non-Profit Organizations (CBO)/NGOs/INGOs

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Role, policies, programmes and relations between people living and working in informality and how they adapt to the effects of climate change.

1. When was your organization formed?
2. Why was it formed/registered?
3. What is your geographic reach?
4. How does your organisation relate to informal economic activities and housing practices in informal settlements?
5. What services do you offer about informal livelihood activities and or housing practices?
6. What is the cost of your service to a client?.
7. Which institutions do you collaborate with in working with informal communities and climate change related issues?.
8. What kind of encounters (both positive and negative) do you usually have with people living and working in informal settlements, especially, and why?
9. What kinds of encounters (both positive and negative) do you usually have with state institutions in supporting people of this community?
10. How does your organisation relate with traditional authorities along the informal coastal communities of Accra, and what is the bearing on development in such communities?
11. Are there any known conflicts that affect livelihood support, housing processes and land tenure in the communities you serve ?.....
12. Who (gender, group of people) are the most vulnerable in these communities and why?.....
13. What is your view on local power relations among actors (traditional authorities, CBOs, Assemblymen, women groups, traders associations, NGOs) about how informal coastal settlements live with effects of climate change (e.g. flooding, temperature rises, coastal erosion and groundwater salinity) in Accra?
14. Have there been any programmes and activities of the CBO over the past 5 years, focused on informal livelihood activities and or housing, and or land tenure? What has been the result?.....
15. Have there been any policies, programmes and activities, or intended to be led by your organization related to informal people and their adaptation to climate change? What has been the result?.....
16. Are there any general challenges faced by your organization in your work in these informal communities?.....
17. What do you recommend should be done on how people throughout the community live with floods, increasing temperatures, coastal erosion, groundwater salinity, if any?.

C. Ministry of Environment, Science and Technology (MEST)

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Policies, programmes and relations with people living and working in informality and the effects of climate change.

2. What is the mandate of the MEST in relation to climate change in Ghana?
3. What is your technical opinion or perception on a linkage between current environmental changes and climate change climate variability and change in Accra? Please provide a brief explanation of your position on climate and variability.
4. In what form do climate change and variability manifest in Accra, if any.
5. Have there been any policies, programmes and activities, or intended to be formulated by the MEST related to informal people and their adaptation to climate change? If yes, what has been the result?
6. Were informal people part of your current policies' formulation, if any, and why?
7. What progress has been made in the implementation of the National Climate Change Adaptation Strategy in relation to urban informal/poor communities?....
8. Are there other institutions you collaborate with in the implementation of the National Climate Change Adaptation Strategy in Accra and urban informal/poor communities?.....
9. What challenges do you face in your collaboration with other institutions in the implementation of the National Climate Change Adaptation Strategy in Accra and urban poor/informal communities?.....
10. What do you suggest as the way forward for people living with climate change/variability related issue in informal settlements Accra?.....

Thank you.

D. Ministry of Local Government and Rural Development (MLGRD)

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Policies, programmes and relations with people living and working in informality and the effects of climate change.

1. What is the mandate of the MLGRD in relation to human settlements, urban economy, urban governance and climate change in Ghana?
2. What is your technical opinion or perception on a linkage between current environmental changes and climate change climate variability and change in Accra? Please provide a brief explanation of your position on climate and variability.
3. What has been the nature of climate change/variability related disasters in Accra (if any) over the last at least 20 years?
4. How does climate change/variability affect the people of Accra?
5. What accounts for informal settlements and activities in Accra?...
6. Have there been any policies, programmes and activities, or intended to be formulated by the MLGRD related to informal people and their adaptation to climate change? If yes, what has been the result?
7. Were informal people part of your current policies' formulation, if any, and why?
8. Are there other institutions you collaborate with in your work, especially in Accra and in urban informal/poor communities?...
9. What challenges do you face in your collaboration with other institutions in the implementation of your policies in Accra and urban poor/informal communities?.....
10. What changes have you been making in your operations in response to the changes and climate-related disasters?.....
11. Does the MLGRD face any challenges that affect your mandate, especially in working with other institutions and communities?.....
12. What do you suggest as the way forward for people living with climate change/variability related issue in informal coastal settlements of Accra?.....

Thank you.

E. Gamashie Development Agency (GAMADA)

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Policies, programmes and relations with people living and working in informality and the effects of climate change

1. What is the mandate of GAMADA in relation to human settlements, urban economy and climate change in Accra?.
2. Has the Gamashie a master plan? If, there is a plan, is it this plan being implemented and updated?
3. How will you describe the urbanisation process, the development and nature of informal settlements in Accra?
4. What accounts for the growth and persistence of informal settlements and the informal economy in Accra?
5. What has been your approach towards informal settlements, concerning their growth and urban planning?
6. What is your view on how Accra has approached the informal economy and informal settlements in the city's planning process?
7. What is your technical view on climate change and its effects in Accra?.
8. How are climate change effects manifested in informal settlements in Accra?
9. Have there been any policies, programmes and activities, or intended to be formulated by the GAMADA related to informal people and their adaptation to climate change? What has been the result?.....
10. Were informal people part of your current policies'/programmes' formulation?
11. How will you describe experiences (hostile or cooperative) between informal settlement residents and city authorities in Accra?
12. Do city officials act outside of planning regulations or official capacity in informal settlements or not, and how?
13. Any general challenges faced by GAMADA in relation to urban governance and climate change/variability?
14. Which institutions does GAMADA collaborate with in relation to managing informal people and settlements? Any challenges in such collaboration?
15. Any recommendations in relation to informal settlements and climate change effects?

Thank you.

F. Ghana Meteorological Service (GMS)

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Views and evidence on climate change/variability in Accra.

1. What has been the nature of weather and climate in Accra over the last at least 30 years?
2. How will you describe the weather and climate of Accra, with respect to the observed long-term changes and variations? Please provide me data over at least the last 30 years.
3. What is your technical opinion on climate change and variability in Accra? Please provide a brief explanation of your position on climate and variability.
4. What has accounted for climate change and variability in Accra, if any?
5. How will future weather and climatic conditions be? Please, assist with projected climatic conditions for Accra.
6. How does climate change/variability affect the people of Accra, if any?
7. How does climate change/variability effects affect informal settlements in coastal Accra, if any?
8. What has been the nature of floods in Accra over the last 10-20 years?
9. What do you think accounts for flooding in Accra, especially in poor coastal communities?
10. How do you serve the people of Accra, especially informal communities facing flooding, and other meteorological related changes?
11. What role does your department play in early warning systems to the residents of informal settlements in Accra?
12. Which institutions do you collaborate with in your work for the residents of Accra?
13. Does your department face any challenges that affect your mandate, especially in working with other institutions and communities? Please briefly explain.
14. What do you see as the way forward for people who live with climate change/variability related issues in informal communities in Accra?

Thank you

G. Metro Town and Country Planning Department (MTCPD)

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Policies, programs and relations with people living and working in informality and the effects of climate change adaptation.

1. What is the mandate of the TCPD, especially in relation to human settlements, urban economy and climate change in Accra?
2. Has the AMA a master plan? If, there is a plan, is it this plan being implemented and updated?
3. How will you describe the urbanisation process, the development and nature of informal settlements in Accra?
4. What accounts for the growth and persistence of informal settlements and the informal economy in Accra?.
5. What has been your approach towards informal settlements, concerning their growth, categorization and urban planning?.
6. Have there been any major land-use changes in informal settlements since the last city's plan?.....
7. What has been the city's main approach towards the informal economy in the city's planning process?.
8. What is the technical view of AMA on climate change/variability in Accra in relation to its likely occurrence and nature and effects? Is there any evidence to support your answer?.
9. How are climate change effects manifested in informal settlements in Accra?.
10. What do you consider as the most significant effects of climate change in informal settlements of Accra?...
11. Have there been any policies, programmes and activities, or intended to be formulated by the TCPD related to informal people and how they cope with climate change? If yes, what has been the result?
12. Were informal people part of your current policies' formulation? Please give examples, if any?.....
13. What is your approach towards the provision of climate responsive infrastructure in informal communities?.....
14. What have been your experiences (hostile or cooperative) in how informal settlement residents organize in coping with climate change effects?
15. Does the municipality enforce development control in informal settlements? How?...

16. Have city officials ever had to act outside of planning regulations or official capacity in preventing harmful effects and or responding to climate change-related effects?
17. Does the AMA have any plans for modernization of Accra? What is the envisaged role for people living and working in informal settlements in such plans?
18. Any general challenges faced by the TCPD in relation to urban governance and climate change/variability?
19. Which institutions do the TCPD collaborate with in relation to managing informal people and settlements?
20. What challenges do you face in such collaboration with other institutions?
21. Any recommendations in relation to informal settlements and climate change effects?.....

Thank you.

H. Accra Metropolitan Assembly (AMA)

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Policies, institutional and resource relations with people living and working in informality and adaptation to effects of climate change/variability.

1. What is the mandate of the AMA, especially in relation to human settlements, urban economy and climate change in the city of Accra?.
2. What is your technical opinion on climate variability and change in Accra?
3. How does the AMA relate with informal economic activities in informal settlements, and why?
4. Have there been any policies, programmes and activities of the AMA since the last Medium Term Development Plan (MTDP) (2003-2009) till date, focused on informal settlements?. What are they?.
5. What AMA's policies, programmes and plans on climate change adaptation have been implemented since your last MTDP, 2003-2009 in informal settlements/communities?
6. Has the assembly implemented any climate change related and general wellbeing interventions in informal coastal communities, especially for Adedenkpo, Ga-Nshonaa, Gbegbeyise and Old Fadama since the most recent MTDP cycle?
7. Which institutions do you collaborate with in relation to responding to climate change/variability effects?
8. What kind of encounters (both positive and negative) do you usually have with people living and working in informal settlements and why?.
9. How does the AMA relate with traditional authorities in informal coastal communities of Accra, especially in Adedenkpo, Ga-Nshonaa, Gbegbeyise and Old Fadama?.
10. Are there any known conflicts that affect livelihood support and climate change adaptation related activities in coastal Accra?
11. What climate change related adaptive responses does the AMA engage in and do these cover informal settlements?
12. What is your view on how the AMA should relate to informal settlements in relation to vulnerability and adaptation to climate change effects along coastal Accra?
13. Is there a way for concerns of people living in informal settlements and working in the informal economy to be presented to the AMA? How are such concerns addressed?
14. Do you face any challenges in your mandate and with coordination with other stakeholders?
15. What would you recommend in relation to informal settlements facing climate change?.....

Thank you

I. Environmental Protection Agency

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

Name of Interviewer:.....

Name of Interviewee:.....

Position of Interviewee:

Date:.....

Time:.....

Areas of focus: Policies, programmes and relations with people living and working in informality and the effects of climate change.

1. What is the mandate of the EPA in relation to climate change in Ghana?
2. What is your technical opinion on climate variability and change in Accra?
3. What has been the nature of climate change/variability related disasters in Accra (if any) over the last at least 10-20 years?
4. How does climate change/variability affect the people of Accra?
5. Have there been any policies, programmes and activities, or intended to be formulated by EPA related to informal people and their adaptation to climate change? If yes, what has been the result?
6. Were informal people part of your current policies' formulation, if any, and why?
7. What progress has been made in the implementation of the NAPA, NCCS in Accra and urban informal/poor communities?
8. Are there other institutions you collaborate with in work, especially the implementation of NC, NCCAS in Accra and urban informal/poor communities?
9. What challenges do you face in your collaboration with other institutions in the implementation of NCCAS in Accra and urban poor/informal communities?...
10. What changes have you been making in your operations in response to the changes and climate related disasters?
11. Does EPA face any challenges that affect your mandate, especially in working with other institutions and communities?.
12. What do you suggest as the way forward for people living with climate change/variability related issue in informal settlements in Accra?.

Thank you.

9.5 APPENDIX 5: SAMPLE INFORMED CONSENT FORM



March 2017

INFORMED CONSENT FORM

ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES

[Redacted] (participant's name) agree to participate in the research project Adaptation to Climate Change in Coastal Urban Informal Settlements in Accra: Practices and Policies being conducted by Dr Sumita Ghosh, sumita.ghosh@uts.edu.au, +61 [Redacted] or +233 [Redacted], School of Built Environment, Faculty of Design and Architecture, Building 6, Level 5, Box 123, Broadway, NSW, 2007, Australia.

I understand that the purpose of this study is to investigate how people who live and work in informal settlements along the coast of Accra cope with the effects of climate change, and the implication for more inclusive and sustainable development in Accra.

I understand that I have been asked to participate in this research because my position indicates that I may be able to provide information regarding this research, and that my participation will involve approximately 1-hour of my time. I also understand that the interview may be recorded and that I can request a copy of the interview and/or the transcript, if I wish, and that my participation is completely voluntary.

I agree to be:

- Audio recorded
 Photographed

I agree that the research data gathered from this project may be published in a form that:

- Identifies me
 Does not identify me in any way
 May be used for future research purposes

I am aware that I can contact Ishmael Adams +233 [Redacted], or the supervisor Dr Sumita Ghosh, if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason.

I agree that Ishmael Adams has answered all my questions fully and clearly.

[Redacted Signature] 10/05/17
Name and Signature (participant) Date

[Redacted Signature] 10/5/17
Name and Signature (researcher or delegate) Date

NOTE:

This study has been approved by the University of Technology Sydney Human Research Ethics Committee (UTS HREC). If you have any concerns or complaints about any aspect of the conduct of this research, please contact the Ethics Secretariat on ph.: +61 2 9514 2478 or email: Research.Ethics@uts.edu.au, and quote the UTS HREC reference number ETH16-1013. Any matter raised will be treated confidentially, investigated and you will be informed of the outcome.

March 2017

**VOLUNTEER ENGAGEMENT AGREEMENT AND HELP-LINES
ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN
ACCRA: PRACTICES AND POLICIES**

I, [redacted] (*volunteer's name*) agree to participate in the research project Adaptation to Climate Change in Coastal Urban Informal Settlements in Accra: Practices and Policies is being conducted by Dr Sumita Ghosh, sumita.ghosh@uts.edu.au, +61 [redacted] or +233 [redacted], School of Built Environment, Faculty of Design and Architecture, Building 6, Level 5, Box 123, Broadway, NSW, 2007, Australia, as **volunteer**.

I understand that the purpose of this study is to investigate how people who live and work in informal settlements along the coast of Accra cope with the effects of climate change, and the implication for more inclusive and sustainable development in Accra.

I understand the following:

Voluntary Acceptance:

1. I have been asked to participate in this research because of my expertise and knowledge of this community, and that my participation will involve approximately [redacted] days of my time.
2. I am satisfied with the explanation that my participation is voluntary and that I can withdraw at anytime without giving reasons and without any consequences.

Respect for and Privacy of Interviewees:

1. I will at all times respect all participants and safeguard their privacy and security. As a result:
 - o I will at all times seek the voluntary participation of each household through reading out Informed Consent Form and Participant Letter;
 - o I will not disclose the identity of any participant beyond the research team to anyone or in any report or publication arising from this research;
 - o I will seek permission of each interviewee, in case I have to record the interview, and I will alert each person that she/he can request a copy of such interview and/or transcript, as needed;
 - o I will alert each interviewee that, she/he is free not to answer any questions that she/he may not be comfortable with;
 - o I will also remind each interviewee that she/he can withdraw from the interview at any stage without need for a reason and without any consequences; and endeavor to answer any questions that may seek any needed clarifications.

Personal Security and Help-Line:

1. I will maintain an active telephone line for daily monitoring by the researcher;
2. I will avoid any controversial situation that threatens my security and or anybody else' during this research;
3. I will not engage in data collection at night;
4. In case of any security and or other problems related to this research, I contact the following people for assistance:
 - o Mr Gabriel Tagoe, +233 [redacted], Executive Director of GAMADA;
 - o Ishmael Adams, +233 [redacted], Research Student.

Compensation:

Though voluntary, I will receive financial compensation of [redacted] which has been satisfactorily discussed with me, before signing this agreement.

I am also aware that I can contact Ishmael Adams +233 [redacted], or the supervisor Dr Sumita Ghosh, if I have any concerns about the research. I also agree that Ishmael Adams has answered all my questions fully and clearly.

Name and Signature (participant) [redacted]

Date

12/04/17

Name and Signature (researcher or delegate) [redacted]

Date

12/04/17

NOTE:

This study has been approved by the University of Technology Sydney Human Research Ethics Committee (UTS HREC). If you have any concerns or complaints about any aspect of the conduct of this research, please contact the Ethics Secretariat on ph: +61 2 9514 2478 or email: Research.Ethics@uts.edu.au, and quote the UTS HREC reference number ETH16-1013. Any matter raised will be treated confidentially, investigated and you will be informed of the outcome.



Ishmael Adams,
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Faculty of Design, Architecture and Building,
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2007, Australia.
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The Head,
Climate Change Unit/Desk,
Ministry of Environment, Science and Technology,
Accra.

27th April 2017.

PERMISSION FOR INTERVIEW ON ACADEMIC RESEARCH

I write to seek your kind approval and consent to organise an interview with an appropriate staff of your esteemed establishment on my PhD research on the topic "ADAPTATION TO CLIMATE CHANGE IN COASTAL URBAN INFORMAL SETTLEMENTS IN ACCRA: PRACTICES AND POLICIES." I am a PhD candidate of the School of Built Environment, University of Technology Sydney. This research seeks to understand how people who live and work in informal settlements along the coast of Accra cope with the effects of climate change/variability, and the policy implications for more inclusive and sustainable development in Accra.

If permission is granted, this interview will last for about an hour or less. In preparation towards this, the interview questions are enclosed in this letter in advance. These questions may also be completed in advance of the interview.

It is my fervent hope that, I will hear favourably from you on a suitable day and time for this interview. I can be reached on [REDACTED].

Yours sincerely,
Ishmael Adams.



A 28/4/17

9.6 APPENDIX 6: DRIVERS ASSOCIATED WITH VULNERABILITY INCLUDING CLIMATE CHANGE-RELATED HAZARDS

VULNERABILITY MODEL (BIVARIATE ANALYSIS)	Crude Odds Ratios						95% C.I.for EXP(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Factors on vulnerability								
Age: Above 60 yrs (Ref. category)			6.141	5	0.293			
Age: 18-25yrs	0.108	0.635	0.029	1	0.866	1.114	0.321	3.868
Age: 26-35yrs	-0.019	0.698	0.001	1	0.978	0.981	0.250	3.855
Age: 36-45yrs	-0.378	0.788	0.230	1	0.631	0.685	0.146	3.212
Age: 46-55yrs	0.041	0.827	0.003	1	0.960	1.042	0.206	5.274
Age: 56-60yrs	1.540	1.016	2.299	1	0.129	4.665	0.637	34.148
Gender (1)/Male(Ref. category)	0.381	0.402	0.898	1	0.343	1.463	0.666	3.216
Ethnicity /Other (Ref. category)			24.347	4	0.060			
Ethnicity: Ga	-1.356	0.490	7.670	1	0.076	0.258	0.099	0.673
Ethnicity: Akan	-1.609	0.627	6.592	1	0.068	0.200	0.059	0.683
Ethnicity: Ewe	-3.055	0.687	19.780	1	0.080	0.047	0.012	0.181
Ethnicity: Mole Dagbani	-1.937	0.718	7.283	1	0.078	0.144	0.035	0.588
Education: Secondary & higher (Ref. category)			1.274	3	0.735			
Education: None	-0.590	0.609	0.939	1	0.333	0.554	0.168	1.829
Education: Primary	-0.497	0.575	0.747	1	0.388	0.609	0.197	1.877
Education: JHS/Middle	-0.234	0.576	0.166	1	0.684	0.791	0.256	2.446
Residential tenancy status of your household/(Landlord(Ref. category)	-0.852	0.390	4.776	1	0.029	2.345	1.092	5.035
Household size: Above 8 (Ref. category)			1.934	2	0.380			
Household size: Less than 5 members	0.767	0.551	1.934	1	0.164	2.152	0.731	6.340
Household size: 5-8 members	18.873	40192.969	0.000	1	1.000	157228271.527	0.000	
Length of stay: Over 30 years(Ref. category)			8.414	3	0.038			
Length of stay: Less than 10 years	0.449	0.407	1.218	1	0.270	1.567	0.706	3.479
Length of stay: 10-20	-1.076	0.469	5.262	1	0.022	2.932	1.170	7.352
Length of stay: 21-30	-1.586	0.583	7.406	1	0.006	4.884	1.559	15.304
Challenge over land/space (including threats of evictions)/ Yes/(Ref. category)	1.215	0.324	14.089	1	0.000	3.370	1.787	6.357
Location of economic activity/In-community/(Ref. category)	0.200	0.276	0.523	1	0.469	1.221	0.711	2.099
Income: Q4: 18500.01 +(Ref. category)			6.690	3	0.082			
Income: Q1: <7000	-0.810	0.408	3.954	1	0.047	0.445	0.200	0.988
Income: Q2: 7000 - 11660	0.561	0.403	1.937	1	0.164	0.571	0.259	1.257
Income: Q3: 11660.01 - 18500	0.087	0.357	0.059	1	0.808	1.091	0.541	2.198
Belonging to any social group/ Yes/(Ref. category)	0.156	0.292	0.287	1	0.592	1.169	0.660	2.072
Climatic Hazard: Temperature and excessive heat(Ref. category)			6.621	6	0.357			
Climatic Hazard: Fire hazard	0.013	0.742	0.000	1	0.986	1.013	0.237	4.337
Climatic Hazard : Coastal Erosion	0.244	1.243	0.038	1	0.844	1.276	0.112	14.592
Climatic Hazard : Sea level Rise	-19.447	19286.973	0.000	1	0.999	0.000	0.000	
Climatic Hazard : Salt water intrusion	1.236	0.777	2.529	1	0.112	3.442	0.750	15.792
Climatic Hazard : Floods	0.063	0.365	0.030	1	0.863	1.065	0.521	2.176
Climatic Hazard : Storms (rain and wind)	-1.019	0.534	3.641	1	0.056	0.361	0.127	1.028
Felt included in the city's governance/ Yes/(Ref. category)	-0.390	0.389	1.004	1	0.316	0.677	0.316	1.452
Awareness of development permitting / Yes/(Ref. category)	0.242	0.387	0.391	1	0.532	1.273	0.597	2.718
Constant	-1.516	0.878	2.982	1	0.084	0.220		

NB: Definitions - CI= Confidence interval; Sig= Significance; S.E= Standard Error, Exp (B)-Adjusted Odds Ratios

Model Fitting Information and Co-efficient					
Model	Model Fitting Criteria	Likelihood Ratio Tests			Pseudo R-Square
	Log Likelihood	Chi-Square	df	Sig.	Nagelkerke
Final	387.309 ^a	223.369	33	0.000	0.490

Source: Author's construct, based on the household survey

9.7 APPENDIX 7: DRIVERS ASSOCIATED WITH VULNERABILITY INCLUDING CLIMATE CHANGE-RELATED HAZARDS (ADJUSTED ODDS RATIOS)

VULNERABILITY MODEL (MULTIVARIATE ANALYSIS)	Adjusted Odds Ratios								
	Factors on vulnerability	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Intercept	1.912	1.672	1.307	1	0.253				
Age	-0.128	0.140	0.845	1	0.358	0.879	0.669	1.156	
Gender	-0.333	0.393	0.719	1	0.396	0.716	0.331	1.549	
Household size	-0.741	0.494	2.249	1	0.134	0.477	0.181	1.255	
Economic activity	-0.055	0.093	0.347	1	0.556	0.947	0.790	1.135	
Educational level	-0.029	0.159	0.033	1	0.856	0.972	0.712	1.326	
Awareness of development permitting / Yes/(Ref. category)	-0.061	0.331	0.034	1	0.854	0.941	0.492	1.799	
Felt included in the city's governance/ Yes/(Ref. category)	0.321	0.358	0.804	1	0.370	1.378	0.683	2.780	
Belonging to any social group/Yes(Ref. category)	-0.133	0.278	0.229	1	0.632	0.875	0.508	1.509	
Ethnicity: Ga	-1.957	0.700	7.819	1	0.350	0.141	0.036	0.557	
Ethnicity: Akan	-0.419	0.685	0.375	1	0.540	0.657	0.172	2.515	
Ethnicity: Ewe	-0.231	0.789	0.086	1	0.770	0.794	0.169	3.724	
Ethnicity: Mole Dagbani	1.131	0.864	1.712	1	0.191	3.099	0.569	16.867	
Ethnicity /Other	0 ^b			0					
Residential tenancy status of your household?/Landlord	0.693	0.382	3.288	1	0.070	1.999	0.946	4.225	
Residential tenancy status of your household?/Tenant	0 ^b			0					
Length of stay: Less than 10 years	1.062	0.542	3.845	1	0.060	2.893	1.001	8.363	
Length of stay: 10-20	0.856	0.524	2.664	1	0.103	2.353	0.842	6.578	
Length of stay: 21-30	0.165	0.469	0.123	1	0.726	1.179	0.470	2.958	
Length of stay: Over 30 years	0 ^b			0					
Challenge over land/space (including threats of evictions)/ Yes/(Ref. category)	1.279	0.306	17.505	1	0.000	3.592	1.973	6.539	
Challenge over land/space (including threats of evictions)/ Yes/(Ref. category)	0 ^b			0					
Income: Q1: <7000	-0.041	0.349	0.014	1	0.907	0.960	0.484	1.902	
Income: Q2: 7000 - 11660	0.650	0.397	2.678	1	0.102	1.915	0.880	4.168	
Income: Q3: 11660.01 - 18500	0.590	0.376	2.455	1	0.117	1.804	0.862	3.771	
Income: Q4: 18500.01 +	0 ^b			0					

NB: Definitions - CI= Confidence interval; Sig= Significance; S.E= Standard Error, Exp (B)-Adjusted Odds Ratios

Model Fitting Information and Co-efficient					
Model	Model Fitting Criteria	Likelihood Ratio Tests			Pseudo R-Square
	Log Likelihood	Chi-Square	df	Sig.	Nagelkerke
Final	392.940	207.222	20	0.000	0.461

Source: Author's construct, based on the household survey

9.8 APPENDIX 8: FACTORS ASSOCIATED WITH STRUCTURAL ADAPTIVE RESPONSES TO MULTIPLE CLIMATIC HAZARDS

ADAPTATION MODEL (BIVARIATE ANALYSIS)	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Age: Above 60 yrs (Ref. category)			5.206	5	0.391			
Age: 18-25yrs	-0.321	0.396	0.656	1	0.418	0.725	0.334	1.578
Age: 26-35yrs	-0.403	0.444	0.824	1	0.364	0.668	0.280	1.596
Age: 36-45yrs	0.063	0.506	0.016	1	0.901	1.065	0.395	2.874
Age: 46-55yrs	-0.743	0.557	1.777	1	0.183	0.476	0.160	1.418
Age: 56-60yrs	-0.751	0.716	1.101	1	0.294	0.472	0.116	1.919
Gender (1)/Male	0.515	0.279	3.405	1	0.065	1.674	0.969	2.892
Education: Secondary & (Ref. category)			1.273	3	0.736			
Education: None	0.109	0.337	0.104	1	0.747	1.115	0.575	2.159
Education: Primary	-0.040	0.331	0.015	1	0.904	0.961	0.503	1.836
Education: JHS/Middle	0.229	0.367	0.388	1	0.533	1.257	0.612	2.581
Ethnicity /Other (Ref. category)			1.988	4	0.738			
Ethnicity: Ga	-0.244	0.339	0.517	1	0.472	0.784	0.403	1.523
Ethnicity: Akan	-0.417	0.440	0.897	1	0.344	0.659	0.278	1.562
Ethnicity: Ewe	-0.336	0.428	0.615	1	0.433	0.715	0.309	1.653
Ethnicity: Mole Dagbani	0.030	0.490	0.004	1	0.951	1.031	0.394	2.695
Length of stay: Over 30 years (Ref. category)			0.651	3	0.885			
Length of stay: Less than 10 years	-0.196	0.293	0.448	1	0.503	0.822	0.463	1.459
Length of stay: 10-20	-0.188	0.385	0.239	1	0.625	0.829	0.390	1.761
Length of stay: 21-30	0.023	0.493	0.002	1	0.963	1.023	0.389	2.690
Residential tenancy status of your household?/ (Landlord/(Ref. category)	-0.484	0.266	3.310	1	0.054	0.616	0.366	1.038
Household size: Above 8 (Ref. category)			0.000	2	1.000			
Household size: Less than 5 members	-0.009	0.437	0.000	1	0.984	0.991	0.420	2.336
Household size: 5-8 members	21.705	40192.969	0.000	1	1.000	26680.887	0.000	
Belonging to any social group/Yes(Ref. category)	-0.151	0.200	0.571	1	0.450	0.860	0.582	1.272
Challenge over land/space (threats of evictions)/Yes(Ref. category)	0.728	0.265	7.542	1	0.006	2.070	1.232	3.479
Main economic activity (Other) (Ref. category)			3.523	5	0.620			
Main household economic activity (Fishing and Fish Mongering)	-0.467	0.322	2.099	1	0.147	0.627	0.333	1.179
Main economic activity(Trade and Commerce)	-0.136	0.408	0.111	1	0.739	0.873	0.393	1.941
Main economic activity(Crafts and industry)	-0.573	0.384	2.228	1	0.136	0.564	0.265	1.197
Main economic activity(Other Services)	-0.160	0.509	0.099	1	0.753	0.852	0.314	2.310
Main economic activity(Unemployed)	-0.239	0.475	0.253	1	0.615	0.787	0.310	1.997
Annual household income_Q4 (18500.1+)(Ref. category)			5.947	3	0.114			
Income_Q1(Less than 7000)	-0.607	0.276	4.850	1	0.028	0.545	0.317	0.935
Income_Q2 (Between 7000 and 11660)	0.291	0.275	1.113	1	0.291	0.748	0.436	1.283
Income_Q3 (Between 11,660.01 and 18500)	0.034	0.280	0.015	1	0.902	0.966	0.558	1.673
Location of household economic activity (within settlement) (Ref. category)	0.281	0.199	1.996	1	0.158	1.325	0.897	1.957
Most important thing affected by hazard/Sensitivity (Livelihood activity) (Ref. category)			1.230	3	0.746			
Most important affected by hazard/(Health and lives)	-0.111	0.243	0.211	1	0.646	0.895	0.556	1.439
Most important affected by hazard/Housing)	-0.266	0.315	0.711	1	0.399	0.767	0.414	1.421
Most important affected by hazard/(Production Assets)	0.098	0.279	0.124	1	0.724	1.103	0.639	1.906
Name Community(Old Fadama) (Ref. category)			15.672	3	0.061			

Name Community(Adedenpko)	-0.798	0.443	3.238	1	0.072	0.450	0.189	1.074
Name Community(Ga Nshonaa)	-0.402	0.298	1.817	1	0.178	0.669	0.373	1.200
Name Community(Gbegbeyise)	0.957	0.479	3.996	1	0.066	2.605	1.019	6.658
Constant	0.444	0.669	0.441	1	0.001			

NB: Definitions - CI= **Confidence interval**; Sig= **Significance**; S.E= **Standard Error**, Exp (B)-**Adjusted Odds Ratios**

Model Fitting Information and Co-efficient					
Model	Model Fitting Criteria	Likelihood Ratio Tests			Pseudo R-Square
	Log Likelihood	Chi-Square	df	Sig.	Nagelkerke
Final	704.745 ^a	75.131	36	0.000	0.164

Source: Author's construct, based on the household survey

9.9 APPENDIX 9: DETAILED RESEARCH OBJECTIVES, QUESTIONS AND DATA COLLECTION METHODS

Thesis objectives	Research questions	Sub-research questions	Data required	Data collection methods
1. Examine the factors that drive the vulnerability of residents of informal settlements to perceived climate change-related hazards as a 'contextual experience' in Accra	Which factors drive the vulnerability of residents of informal settlements to climate change-related hazards as a 'contextual experience.'	Which social, economic, political and institutional factors influence the perceived vulnerability of residents of informal settlements to perceived climate change-related hazards?	Social, economic, political characteristics, regulatory/legal barriers and physical factors; employment, access to labour and land markets, relation with employers, access to infrastructure and services, housing characteristics, community cohesion, awareness of building regulations, belonging to a group, access to community resources, nature of involvement in the governance of the city, exposure to climate change-related hazards.	Household survey, Focus groups; Institutional interviews; Collection of reports and policies; Photography; Observation.
		What are the most frequently experienced perceived climate change-related hazards among the residents of informal settlements?	Climate variability and change impacts: meteorological data, such as temperature and rainfall variability, effects of previous climate-related events.	Institutional interviews
2. Assess the potential influences of the socio-economic context of the residents of informal settlements on their knowledge and capacity to respond to potential climate change in Accra	In which way does the context of residents of informal settlements influence their knowledge and 'capacity to respond' to potential climate change?	What are the perceptions of climate-related environmental changes among residents of informal settlements and the synergies with scientific knowledge on climate change-related phenomena?	Households' knowledge of environmental changes and climate change; scientific data on climate change	Household survey; Focus groups; Interviews with state officials Photography; Observation.
		How do the socio-demographic characteristics of residents of informal settlements influence their knowledge of climate change and variability compared to the perspectives of state officials on the same?	Households' knowledge of climate change and scientific data on climate change	Household survey; Interviews with state officials; Photography; Observation.
		How does the socio-political context of residents of informal settlements influence their access to an early warning on climate change-related phenomena?	Households' demographics and access to knowledge of climate change.	Household survey
3. Examine who adapts to what and why in the context of climate change-related hazards in informal settlements.	Who adapts to what and why in the context of climate change-related hazards in informal settlements?	What responses are adopted to address socio-economic contextual vulnerabilities in relation to climate change/variability	Types of economic adaptation responses by different households in relation to their social contextual and climate change-related hazards.	Household survey; livelihood/occupation/trade related focus groups discussions
		How do socio-economic characteristics of residents of informal settlements relate to their adaptation options to climate change-related hazards in their built environment?	Adaptation options by various households to three major climate change-related hazards (flooding, excessive heat and storms).	Household survey
		What funding and/or support mechanisms are adopted for minimising social contextual and climate change-related vulnerabilities in the informal settlement?	Nature of institutional interventions and collective action in response to contextual and climate change impacts in the various communities.	Institutional interviews Household survey Collection of reports and policies Focus group discussions

9.10 APPENDIX 10 OTHER RESULTS TABLES

Table 1: Age Distribution of Respondents by Community and Gender

Community/Settlement and age			Gender		Total	
			Male	Female		
Adedenpko	18-25yrs	%	10.4	8.7	10.1	
	26-35yrs	%	27.2	30.4	27.7	
	36-45yrs	%	18.4	21.7	18.9	
	46-55yrs	%	18.4	4.3	16.2	
	56-60yrs	%	15.2	21.7	16.2	
	61+ yrs	%	10.4	13.0	10.8	
	Total	N		125	23	148
		%		100.0	100.0	100.0
Ga-Nshonaa	18-25yrs	%	14.0	33.3	15.2	
	26-35yrs	%	60.5	44.4	59.4	
	36-45yrs	%	19.4	11.1	18.8	
	46-55yrs	%	5.4	11.1	5.8	
	56-60yrs	%	0.8	0.0	0.7	
	Total	N		129	9	138
		%		100.0	100.0	100.0
	Gbegbeyise	18-25yrs	%	1.6	0.0	1.4
26-35yrs		%	44.8	28.6	42.5	
36-45yrs		%	29.6	33.3	30.1	
46-55yrs		%	15.2	28.6	17.1	
56-60yrs		%	7.2	9.5	7.5	
61+yrs		%	1.6	0.0	1.4	
Total		N		125	21	146
		%		100.0	100.0	100.0
Old Fadama	18-25yrs	%	0.0	10.0	1.3	
	26-35yrs	%	56.9	65.0	58.0	
	36-45yrs	%	25.4	10.0	23.3	
	46-55yrs	%	10.8	10.0	10.7	
	56-60yrs	%	6.9	5.0	6.7	
	Total	N		130	20	150
		%		100.0	100.0	100.0

Source: Author's construct, based on the household survey

Table 2: Educational Level of Respondents by Community and Gender

Community/settlement and level of education			Gender		Total
			Male	Female	
Adedenpko	Primary	%	16.8	13.0	16.2
	Junior High Sch.	%	27.2	30.4	27.7
	Mid. Sch. Lev. Cert.	%	24.0	21.7	23.6
	Sen. High Sch.	%	12.8	4.3	11.5
	Vocational/Technical	%	8.0	4.3	7.4
	Tertiary	%	6.4	8.7	6.8
	Professional	%	0.8	0.0	0.7
	None	%	4.0	17.4	6.1
	Total	N	125	23	148
	%	100.0	100.0	100.0	
Ga-Nshonaa	Primary	%	38.0	44.4	38.4
	Junior High Sch.	%	29.5	33.3	29.7
	Mid. Sch. Lev. Cert.	%	0.8	0.0	0.7
	Sen. High Sch.	%	7.0	11.1	7.2
	Vocational/Technical	%	3.9	11.1	4.3
	Tertiary	%	1.6	0.0	1.4
	None	%	19.4	0.0	18.1
	Total	N	129	9	138
		%	100.0	100.0	100.0
Gbegbeyise	Primary	%	12.0	28.6	14.4
	Junior High Sch.	%	33.6	38.1	34.2
	Mid. Sch. Lev. Cert.	%	12.8	23.8	14.4
	Sen. High Sch.	%	25.6	4.8	22.6
	Vocational/Technical	%	4.0	0.0	3.4
	Tertiary	%	8.0	0.0	6.8
	None	%	4.0	4.8	4.1
	Total	N	125	21	146
		%	100.0	100.0	100.0
Old Fadama	Primary	%	40.0	50.0	41.3
	Junior High Sch.	%	31.5	20.0	30.0
	Mid. Sch. Lev. Cert.	%	1.5	0.0	1.3
	Sen. High Sch.	%	6.2	10.0	6.7
	Vocational/Technical	%	5.4	5.0	5.3
	None	%	15.4	15.0	15.3
	Total	N	130	20	150
		%	100.0	100.0	100.0

Table 3: Percentage of Male and Female Respondents Who Belong to Groups in the Study Communities

Community/Settlement Belonging to Group			Gender		Total
			Male	Female	
Adedenkpo	Yes	N	74	14	88
		%	59.2	60.9	59.5
	No	N	51	9	60
		%	40.8	39.1	40.5
	Total	N	125	23	148
		%	100.0	100.0	100.0
Ga-Nshonaa	Yes	N	46	2	48
		%	35.7	22.2	34.8
	No	N	83	7	90
		%	64.3	77.8	65.2
	Total	N	129	9	138
		%	100.0	100.0	100.0
Gbegbeyise	Yes	N	39	7	46
		%	31.2	33.3	31.5
	No	N	86	14	100
		%	68.8	66.7	68.5
	Total	N	125	21	146
		%	100.0	100.0	100.0
Old Fadama	Yes	N	48	8	56
		%	36.9	40.0	37.3
	No	N	82	12	94
		%	63.1	60.0	62.7
	Total	N	130	20	150
		%	100.0	100.0	100.0

Table 4: Perceived Timing of Climatic-related Variables in the Study Communities

Timing of climatic-related variable		Community/Settlement				Total
		Adedenkpo	Ga-Nshonaa	Gbegbeyise	Old Fadama	
Rainfall Patterns/Timing of Rainfall						
May-October	N	122	114	128	131	495
	%	82.4	82.6	87.7	87.3	85.1
November-April	N	10	7	3	0	20
	%	6.8	5.1	2.1	0.0	3.4
Not very sure	N	11	9	8	11	39
	%	7.4	6.5	5.5	7.3	6.7
Whole year	N	5	8	7	8	28
	%	3.4	5.8	4.8	5.3	4.8
Flooding						
May-October	N	122	114	128	128	492
	%	82.4	82.6	87.7	85.3	84.5
November-April	N	10	7	3	6	26
	%	6.8	5.1	2.1	4.0	4.5
Not very sure	N	11	9	8	10	38
	%	7.4	6.5	5.5	6.7	6.5
Whole year	N	5	8	7	6	26
	%	3.4	5.8	4.8	4.0	4.5
Storms (rainstorms/windstorms)						
May-October	N	119	112	127	130	488
	%	80.4	81.2	87.0	86.7	83.8
November-April	N	15	10	9	6	40
	%	10.1	7.2	6.2	4.0	6.9
Not very sure	N	11	9	6	7	33
	%	7.4	6.5	4.1	4.7	5.7
Whole year	N	3	7	4	7	21
	%	2.0	5.1	2.7	4.7	3.6
Temperature Change and Excessive Heat						
December-March	N	114	107	121	125	467
	%	77.0	77.5	82.9	83.3	80.2
April-August	N	17	13	10	6	46
	%	11.5	9.4	6.8	4.0	7.9
Not very sure	N	11	10	8	11	40
	%	7.4	7.2	5.5	7.3	6.9
Whole year	N	6	8	7	8	29
	%	4.1	5.8	4.8	5.3	5.0

Source: Author's construct, based on the household survey

Table 5: Respondents who Perceived Changes in Coastal Erosion, Sea level rise and salt water intrusion by Length of Stay in the Study Communities

Community/Settlement			Length of stay in the community				Total
			Less than 10 yrs.	10-20 yrs.	21-30 yrs.	Over 30 yrs.	
Coastal erosion							
Adedenkpo	Coastal erosion	There has been a change	N	0	0	0	0
			%	0.0	0.0	0.0	0.0
Ga-Nshonaa	Coastal erosion	There has been a change	N	76	56	0	132
			%	93.8	98.2	0	95.7
Gbegbeyise	Coastal erosion	There has been a change	N	62	22	14	127
			%	89.9	81.5	93.3	82.9
Old Fadama	Coastal erosion	There has been a change	N	0	0	0	0
			%	0.0	0.0	0.0	0
Sea level rise							
Adedenkpo	Sea level rise	There has been a change	N	0	0	0	0
			%	0.0	0.0	0.0	0.0
Ga-Nshonaa	Sea level rise	There has been a change	N	77	56	0	133
			%	95.1	98.2	0	96.4
Gbegbeyise	Sea level rise	There has been a change	N	63	24	14	130
			%	91.3	88.9	93.3	82.9
Old Fadama	Sea level rise	There has been a change	N	0	0	0	0
			%	0.0	0.0	0.0	0
Saltwater intrusion							
Adedenkpo	Saltwater intrusion	There has been a change	N	32	6	10	89
			%	69.6	42.9	47.6	61.2
Ga-Nshonaa	Saltwater intrusion	There has been a change	N	64	51	0	115
			%	79.0	89.5	0	83.3
Gbegbeyise	Saltwater intrusion	There has been a change	N	41	8	11	76
			%	59.4	29.6	73.3	45.7
Old Fadama	Salt water intrusion	There has been a change	N	0	0	5	5
			%	0.0	0.0	6.9	0

Source: Author's construct, based on the household survey

Table 6: Perceived Linkage between Environmental Changes and Climate Change by Education Levels in the Study Communities

Community/Settlement			Educational level (recategorised)				Total
			None	Primary	JHS/Middle	Secondary and higher	
Adedenkpo	Yes	N	9	23	75	37	144
		%	100	95.8	98.7	94.9	97.3
	No	N	0	1	1	2	4
		%	0.0	4.2	1.3	5.1	2.7
	Total	N	9	24	76	39	148
		%	6.1	16.2	51.4	26.4	100.0
Ga-Nshonaa	Yes	N	25	51	42	18	136
		%	100	96.2	100	100	98.6
	No	N	0	2	0	0	2
		%	0.0	3.8	0.0	0.0	1.4
	Total	N	25	53	42	18	138
		%	18.1	38.4	30.4	13.0	100.0
Gbegbeyise	Yes	N	6	21	70	47	144
		%	100	100	98.6	97.9	98.6
	No	N	0	0	1	1	2
		%	0.0	0.0	1.4	2.1	1.4
	Total	N	6	21	71	48	146
		%	4.1	14.4	48.6	32.9	100.0
Old Fadama	Yes	N	22	60	46	18	146
		%	95.7	96.8	97.9	100	97.3
	No	N	1	2	1	0	4
		%	4.3	3.2	2.1	0.0	2.7
	Total	N	23	62	47	18	150
		%	15.3	41.3	31.3	12.0	100.0

Source: Author's construct, based on the household survey

Table 7: Perceived Main Causes of Climate Change According to Education Level in the Study Communities

Community/Settlement and causes of climate change			Level of education								Total
			Primary	Jun. High. Sch.	Mid. Sch. Leav. Cert.	Sen. High. Sch.	Vocational/ Technical	Tertiary	Professional	None	
Adedenkpo	Act of God	N	0	1	1	0	0	0	0	9	11
		%	0.0	2.4	2.9	0.0	0.0	0.0	0.0	100.0	7.4
	Community/ local activities	N	24	38	34	17	0	0	0	0	113
		%	100.0	92.7	97.1	100.0	0.0	0.0	0.0	0.0	76.4
	Global industrial activity	N	0	0	0	0	11	10	1	0	22
		%	0.0	0.0	0.0	0.0	100.0	100	100	0.0	14.9
Other	N	0	2	0	0	0	0	0	0	2	
	%	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	1.4	
Ga-Nshonaa	Act of God	N	0	0	0	0	0	0	0	25	25
		%	0.0	0.0	0.0	0.0	0.0	0.0	0	100.0	18.1
	Community/ local activities	N	53	39	1	10	0	0	0	0	103
		%	100.0	95.1	100.0	100.0	0.0	0.0	0	0.0	74.6
	Global industrial activity	N	0	0	0	0	6	2	0	0	8
		%	0.0	0.0	0.0	0.0	100.0	100.0	0	0.0	5.8
Other	N	0	2	0	0	0	0	0	0	2	
	%	0.0	4.9	0.0	0.0	0.0	0.0	0	0.0	1.4	
Gbegbeyise	Act of God	N	0	0	0	0	0	0	0	5	5
		%	0.0	0.0	0.0	0.0	0.0	0.0	0	83.3	3.4
	Community/ local activities	N	20	48	21	31	1	1	0	1	123
		%	95.2	96.0	100.0	93.9	20.0	10.0	0	16.7	84.2
	Global industrial activity	N	0	0	0	0	4	9	0	0	13
		%	0.0	0.0	0.0	0.0	80.0	90.0	0	0.0	8.9
Other	N	1	2	0	2	0	0	0	0	5	
	%	4.8	4.0	0.0	6.1	0.0	0.0	0	0.0	3.4	
Old Fadama	Act of God	N	0	0	0	0	0	0	0	22	22
		%	0.0	0.0	0.0	0.0	0.0	0	0	95.7	14.7
	Community/ local activities	N	58	41	2	9	1	0	0	1	112
		%	93.5	91.1	100.0	90.0	12.5	0	0	4.3	74.7
	Global industrial activity	N	0	0	0	0	7	0	0	0	7
		%	0.0	0.0	0.0	0.0	87.5	0	0	0.0	4.7
Other	N	4	4	0	1	0	0	0	0	9	
	%	6.5	8.9	0.0	10.0	0.0	0	0	0.0	6.0	

Source: Author's construct, based on the household survey

Table 8: Main Source of Early Warning over the Last 1-2 years in the Study Communities

Community/Settlement and main source of early warning over 1 to 2 years			Gender		Total
			Male	Female	
Adedenkpo	Radio	N	46	9	55
		%	36.8	39.1	37.2
	TV	N	50	11	61
		%	40.0	47.8	41.2
	Self/friends/relatives	N	25	3	28
		%	20.0	13.0	18.9
	Government officials	N	4	0	4
		%	3.2	0.0	2.7
	Total	N	125	23	148
		%	100.0	100.0	100.0
Ga-Nshonaa	Radio	N	2	0	2
		%	1.6	0.0	1.4
	Self/friends/relatives	N	113	9	122
		%	87.6	100.0	88.4
	Community-based group	N	14	0	14
		%	10.9	0.0	10.1
	Total	N	129	9	138
		%	100.0	100.0	100.0
Gbegbeyise	Radio	N	14	2	16
		%	11.2	9.5	11.0
	TV	N	75	11	86
		%	60.0	52.4	58.9
	Self/friends/relatives	N	29	6	35
		%	23.2	28.6	24.0
	Community-based group	N	7	2	9
		%	5.6	9.5	6.2
	Total	N	125	21	146
		%	100.0	100.0	100.0
Old Fadama	Radio	N	48	5	53
		%	36.9	25.0	35.3
	TV	N	61	5	66
		%	46.9	25.0	44.0
	Self/friends/relatives	N	20	6	26
		%	15.4	30.0	17.3
	Community-based group	N	1	4	5
		%	0.8	20.0	3.3
	Total	N	130	20	150
		%	100.0	100.0	100.0

Source: Author's construct, based on the household survey

Table 9: Awareness and application of informal knowledge of climate change

Community/Settlement			Gender		Total
			Male	Female	
Adedenkpo	Yes	N	117	22	139
		%	93.6	95.7	93.9
	No	N	8	1	9
		%	6.4	4.3	6.1
	Total	N	125	23	148
		%	100.0	100.0	100.0
Ga Nshonaa	Yes	N	94	7	101
		%	72.9	77.8	73.2
	No	N	35	2	37
		%	27.1	22.2	26.8
	Total	N	129	9	138
		%	100.0	100.0	100.0
Gbegbeyise	Yes	N	107	15	122
		%	85.6	71.4	83.6
	No	N	18	6	24
		%	14.4	28.6	16.4
	Total	N	125	21	146
		%	100.0	100.0	100.0
Old Fadama	Yes	N	113	19	132
		%	86.9	95.0	88.0
	No	N	17	1	18
		%	13.1	5.0	12.0
	Total	N	130	20	150
		%	100.0	100.0	100.0

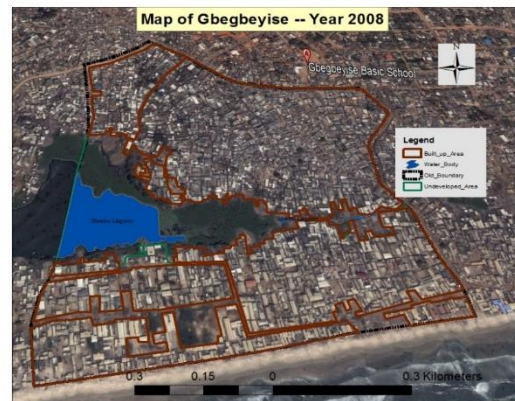
Source: Author's construct, based on the household survey

Table 10: Reported Number of Times of Illness in a Year

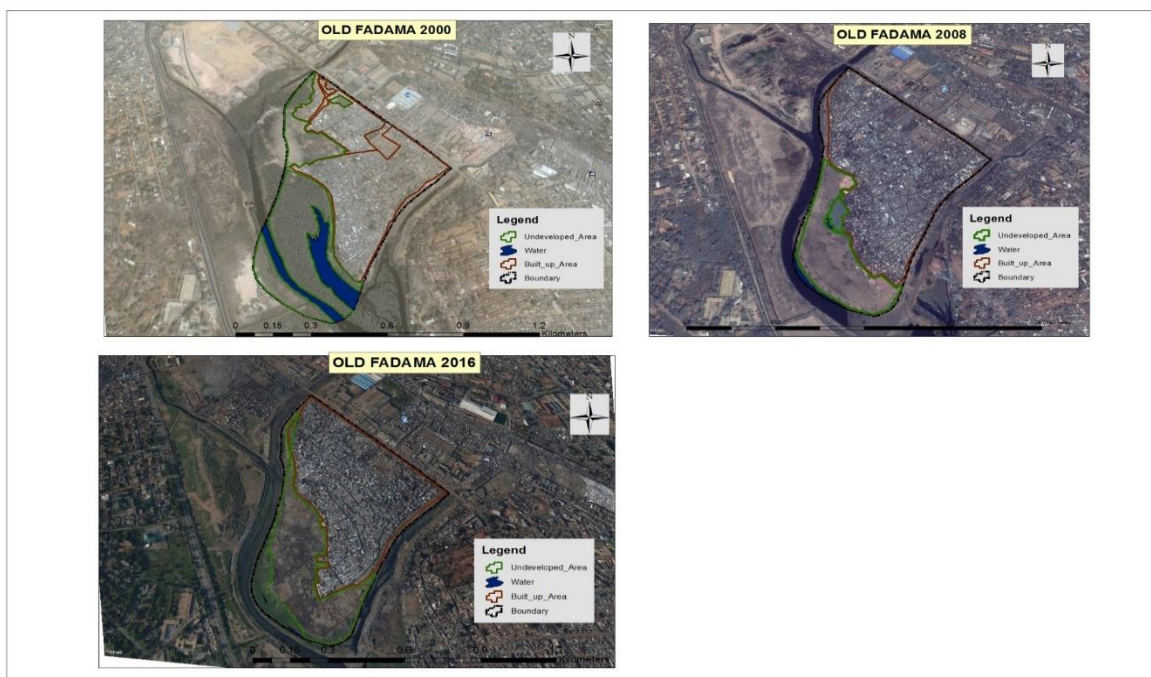
Community/Settlement and frequency of illness			Gender		Total
			Male	Female	
Adedenpko	Once	%	36.0	39.1	36.5
	Twice	%	18.4	8.7	16.9
	Three times	%	5.6	13.0	6.8
	More than three	%	4.0	4.3	4.1
	None	%	36.0	34.8	35.8
	Total	N	125	23	148
	%	100.0	100.0	100.0	
Ga-Nshonaa	Once	%	49.6	33.3	48.6
	Twice	%	27.9	44.4	29.0
	Three times	%	7.8	0.0	7.2
	More than three	%	3.1	0.0	2.9
	None	%	11.6	22.2	12.3
	Total	N	129	9	138
	%	100.0	100.0	100.0	
Gbegbeyise	Once	%	41.6	52.4	43.2
	Twice	%	32.8	19.0	30.8
	Three times	%	4.0	4.8	4.1
	More than three	%	3.2	0.0	2.7
	None	%	18.4	23.8	19.2
	Total	N	125	21	146
	%	100.0	100.0	100.0	
Old Fadama	Once	%	44.6	55.0	46.0
	Twice	%	32.3	25.0	31.3
	Three times	%	9.2	10.0	9.3
	More than three	%	5.4	5.0	5.3
	None	%	8.5	5.0	8.0
	Total	N	130	20	150
	%	100.0	100.0	100.0	

9.11 APPENDIX 11: ADDITIONAL MAPS ON THE STUDY SETTLEMENTS

9.11.1 Maps showing encroachments on the Gbebu Lagoon in Gbegbeyise



9.11.2 Maps showing physical evidence of encroachment on the Korle Lagoon and consequent forced evictions in Old Fadama in 2000, 2008 and 2016.



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