

REGIONAL INSTITUTE FOR POPULATION STUDIES AT THE
UNIVERSITY OF GHANA

**Household Vulnerability and Adaptation Options in
Resource-Poor Communities in Accra, Ghana**

BY

AARON KOBINA CHRISTIAN

(10040747)

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ACCEPTANCE

Accepted by the Faculty of Social Science, University of Ghana, Legon, in fulfilment of the requirements for the award of a Doctorate of Philosophy Degree in Population Studies.

Supervisor of Thesis:

PROF. SAMUEL NII ARDEY CODJOE

Date:

Supervisor of Thesis:

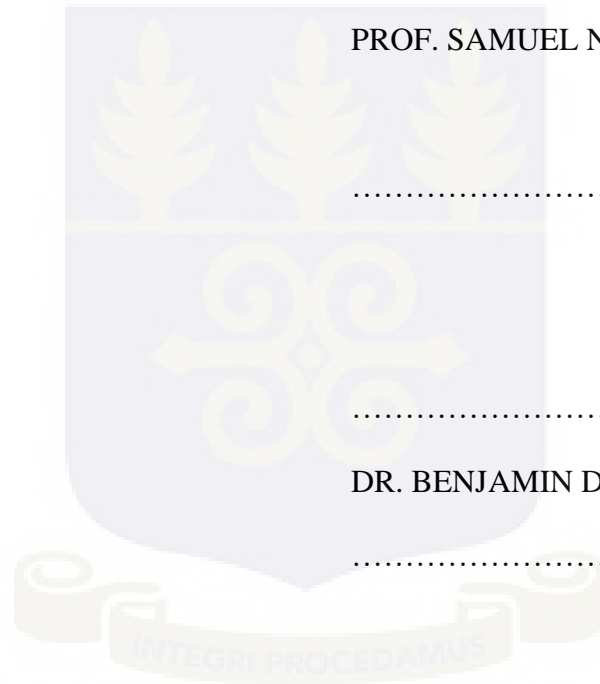
DR. BENJAMIN DELALI DOVIE

Date:

Supervisor of Thesis:

PROF. WISDOM AKPALU

Date:



DECLARATION

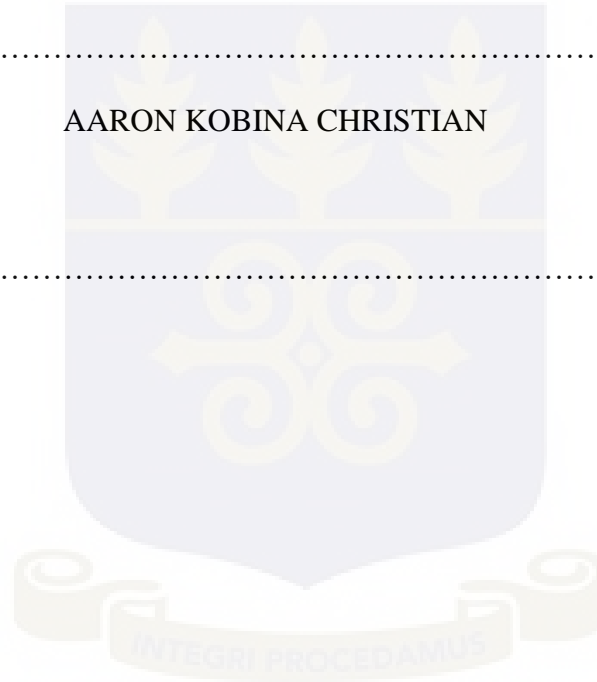
I hereby declare that, except for reference to other people's works which have been duly acknowledged, this work is the result of my research and that it has neither in part nor in whole been presented elsewhere for another degree.

Signed:

.....
AARON KOBINA CHRISTIAN

Date:

.....



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DEDICATION

To my father Mr Samuel Ato Christian, mother, Madam Henrietta Ampong, Step-mother Mrs Dorothy Christian, my beloved wife Benedicta Esther Christian and children-Lois Ewuradzeba Christian, Samantha Nyamedze Christian, Lemuel Aseda Christian and Raphael Nyameye Christian- and my dear sister Mrs Shirley Efua Assa-Awah.

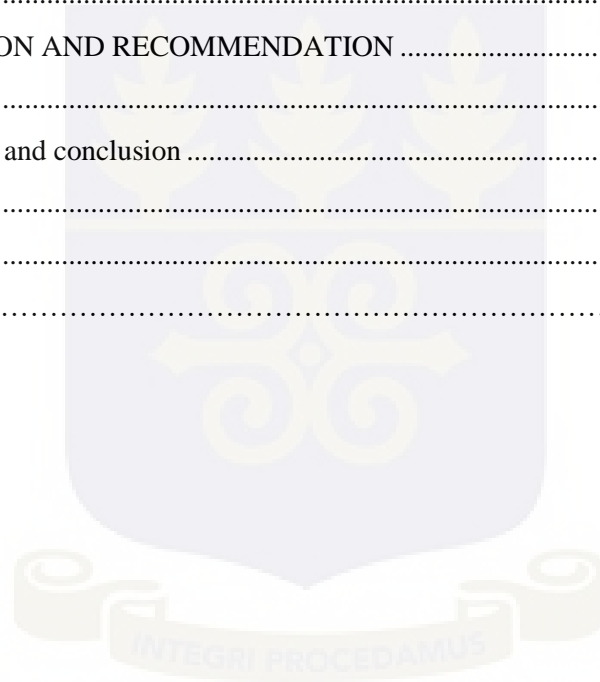


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ABSTRACT

The current impact of climate variability highlights the need for an increased understanding of the relationship between climate-sensitive disasters such as floods, vulnerability, and adaptation/coping strategies of households. With few exceptions, given the variations in socio-demographic and economic characteristics, floods tend to have a disproportionate impact on resource-poor urban communities, particularly in developing countries.

This study aimed to; (1) identify indicators of household vulnerability to floods and compute a household vulnerability index, (2) compare household's perceived vulnerability to flood to the computed vulnerability, and finally (3) examine the relationship between the various components of households' vulnerability and selected household coping/adaptation options. The source of data was a cross-sectional community survey from two resource-poor urban communities: Agbogbloshie and James Town in Accra, Ghana.

Results showed that households in Agbogbloshie were more vulnerable to floods compared to their counterparts in James Town. More than half of the households underestimated their vulnerability to floods when compared to their computed vulnerability index. Among female household heads, those married and those who were unemployed were more likely to underestimate their vulnerability compared to those who were unmarried and employed. Among male household heads, a quadratic relationship was found between their age in years and underestimation of vulnerability. The relationship indicates that the likelihood to underestimate vulnerability to floods decreases as the age of the male household head increases up to a turning point (45 years), beyond which they become more likely to underestimate vulnerability. Components of household's Adaptive capacity- sociodemographic profile, social capital- and Sensitivity- food insecurity- were significant predictors of households relocating as a coping strategy to floods.

The study buttresses the need to acknowledge the impact of social capital and food security alongside conventional structural measures in addressing relocation because of floods. There is also a need to explore gendered perspectives of vulnerability to understand specific modulators of perception in resource-poor urban communities. These will in turn guide community interventions more efficiently.

CHAPTER ONE

INTRODUCTION

1.0 Background

Current scholarship on anthropogenic climate change and climate variability demonstrate that human societies will continue to experience the impact of this change even after increased efforts to reduce the emission of greenhouse gases (Mendelsohn et al., 2012, Perry, 2015). Except for few exceptions, observable trends in climate change and variability increases the vulnerability of developing countries more than their counterparts in developed countries. Climate variability and the increasing level of urbanization, particularly in resource-poor communities in the sub-Saharan African region pose significant threats to flooding and its management. Current variations in the magnitude(depth) and timing (duration) of rainfall event predict an increase in flooding in Accra, Ghana (Kwaku and Duke, 2007). This is because the surface runoff generated by high-intensity short-duration (HI-SD) rainfall/storms in Accra which can be attributed to climate variability often exceeds the infiltration rates and the amount of water current drainage systems can take (Alfa et al., 2011). This leads to pluvial flooding, particularly in low-laying resource-poor communities by the coast.

Although the resulting impact of these floods disproportionately affect the poor, young, elderly, sick, and marginalized populations (Kasperson and Kasperson, 2001, Mendelsohn et al., 2006), existing scholarship on assessment of vulnerability to floods have been skewed more towards regional, country and community level assessments which miss this nuance. The exact impact of floods and most importantly the appropriateness of methods employed to assess the vulnerability of communities, households and individuals are still evolving and often contested. This is because,

besides the disproportionate exposure to climatic hazards, the diverse values, goals and susceptibility of societies lead to the ranking of their vulnerabilities differently (IPCC, 2014). These differences can primarily be attributed to differences in assets and entitlements peculiar to different spatial locations or communities (Field et al., 2014, Haddad and Prats, 2012). The vulnerability of a place, a community or a household is dependent not only on the climatic stressor, in this case, flooding, but also on the prevailing sociodemographic, economic and perceptions of the populace. The sociodemographic, environmental and economic characteristics of a place either amplify or reduce experienced climatic stressors and influence the selection of a particular coping or adaptation strategy (Cardona et al., 2012). There is, therefore, an increased call for methods used to assess the vulnerability of a system (places, communities and households) to consider the factors that make them more susceptible to climatic stressors as well as the characteristics that influence their capacity to withstand experienced hazards.

A vulnerability approach to climate-related hazards can help contextualise and identify how the livelihoods of different people are affected by climate change and variability (Ng'ang'a et al., 2013). Consequently, a holistic investigation of the vulnerability of households considering the extent of exposure, their sensitivity and inherent adaptive capacity will provide some understanding of the various adaptations and/or coping strategies households employ to mitigate the situation.

Additionally, individuals' and households' perception concerning their vulnerability to a climatic stressor, such as floods, are also created within a social context (Shakeela and Becken, 2013) and likely to influence their coping or adaptation measures. While misrepresentation or denial of household vulnerability may lead to maladaptation (Mortreux and Barnett, 2009, Wolf and Moser, 2011, Uzzell, 2000), what influences how households perceive or estimates, particularly

underestimate their vulnerability to climatic hazards such as floods has rarely been investigated. Hence besides computing for a vulnerability index, this study also determines households' own perceived vulnerability to the climatic hazard.

Developing a household vulnerability index in accordance with the Sustainable Livelihood Approach and the Intergovernmental Panel on Climate Change (IPCC) definition of vulnerability (a function of exposure, adaptive capacity and sensitivity), this research compares the computed vulnerability index with households' own perceived vulnerability and also investigates how the various factors of household's vulnerability influence their choice of coping and/or adaptation strategies in the wake of the climatic hazard.

1.1 Problem statement

Climate change is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as a change in climate that is attributed directly or indirectly to human activity, altering the composition of the global atmosphere (United Nations, 1992) often over period not less than thirty years, while climate variability refers to changes in climate that fall within the normal range of extremes for a region, as measured by temperature, precipitation, and frequency of events. The World Meteorological Organization also defines climate variability as "variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events (Stocker, 2014). Climate change is 'inevitably resulting in changes in climate variability and in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events' (IPCC, 2012b).

The impact of climate change and variability varies across spatial scales and disproportionately affects resource-poor urban populations, particularly in developing countries (Ali et al., 2014,

McIver et al., 2015). Vulnerability to climate change is generally high in these regions due to existing social, economic and environmental conditions that heighten susceptibility to the negative impacts of climate change (Leary and Kulkarni, 2007). There is clear evidence that the exacerbated impact of climatic stressors such as flooding occurs more in poor urban centres. This is because these communities are already characterized by low income, poor education and health profiles, insecure tenure, inadequate or poor infrastructure, financial insecurity and personal insecurity. Current evidence alludes to the fact that coastal erosion and annual flooding continue to threaten the livelihoods and well-being of coastal communities, particularly in urban centres in sub-Saharan African cities including Accra (Boateng et al., 2012, Appeaning Addo et al., 2011).

Despite the uniqueness of these different communities and locations, most methodologies contributing to the theoretical underpinnings and measurements of vulnerability and adaptation strategies have been based on regional or national levels assessment and indicators (Brooks et al., 2005, Rinne et al., 2013, Füssel, 2007b, Hinkel, 2011). Although useful, relying on emanating themes from regional and national levels and downscaling of such measures to the community and household level usually misses the influence of existing social, cultural and political dynamics that may influence vulnerability and choice of adaptation options (Shah et al., 2013). This is even against the backdrop that downscaling methodologies employed at the global and regional levels for accessing the extent of vulnerability and adaptive capacities continue to be challenged because of the wide variations in several projected estimates from climate models.

The selection of appropriate indicators for the computation of vulnerability is not static but continues to receive much attention because the effects of climate-induced pressures are mediated by the existing social and environmental conditions. Surprisingly, this has not led to an investigation into how the perceived vulnerability of households compares with computed

vulnerability. Consequently, an important inquiry in this research is the relationship between households' perceived vulnerability and their computed vulnerability.

Rapid urbanization in Ghana over the past four decades - 23.0% in 1960 to 43.8% in 2000 and 51.0% in 2010 - has resulted in an upsurge of people living in already vulnerable areas in cities like Accra (GSS, 2012). The current study communities are faced with pressures from poor social amenities and exposure to flooding on yearly basis. Existing conditions lead to increased morbidity and mortality in the event of floods. It is therefore plausible that households will engage in some coping and/or adaptation strategies which may reflect their various degrees of vulnerability.

Theories and methods for vulnerability assessments are still evolving; empirical studies linking households' vulnerability to their coping and adaptation strategies have been overlooked. Addressing these gaps in literature will provide useful information not only for climate change intervention but also general disaster management practices, particularly in resource-poor communities.

1.2 Research questions

Against the background of the unique characteristics of resource-poor urban communities in Ghana, the study seeks to answer the following questions:

1. What are the indicators of vulnerability to floods in resource-poor urban communities in Accra?
2. How does household vulnerability differ between the study communities –James Town and Agbogbloshie?
3. How do households perceive their vulnerability to floods?

4. What are the characteristics of households that underestimate their vulnerability?
5. How does households' vulnerability influence their coping/adaptation strategies?

1.3 Study rationale

Although climate change is a global phenomenon, its expressions and impacts are experienced at the micro or local level. Yet, the appropriate scale for climate vulnerability analysis continues to be contested. Micro-level analyses have received less attention compared to ecosystem research on biophysical vulnerability (Ghimire et al., 2010, Marshall et al., 2014). Moreover, planning and major decision-making pertaining to coping and/or adaptation to climate-induced hazards and livelihood processes are made at this level (Thomas, 2008, Madu, 2012). Adger (2000) strongly suggests that vulnerability is location specific, thus the selection of parameters should be indicative of the level of interest. This idea has been advanced and consolidated in subsequent works (Kelly and Adger, 2000). Ng'ang'a et al (2012) also states that due to the level of uncertainty associated with climate change projections, there is a demand for methodologies that rely more on the unique characteristics of the quantity in question. Consequently, this study focused on household-level vulnerability analysis.

The generation of vulnerability indices that consider elements of adaptive capacity and sensitivity but not only exposure (climatic hazard, flood) of a household is very laudable. This is because besides exposure to climatic stressors like flood, peoples' vulnerability is a reflection of their sociodemographic, economic and ecological conditions (Nkondze et al., 2013).

Review of current literature, particularly among the resource-poor urban setting identified few that sought to find the link between the vulnerability of households and their coping and adaptation strategies. Also, the heterogeneity of the urban poor, coupled with their varying idiosyncrasies,

give much credence to the investigation of their perceived vulnerability. The perceptions of vulnerability to climatic hazards are culturally and socially constructed and lead to differences in the representation of potentially hazardous situations (McIvor and Paton, 2007). Besides computing for household livelihood vulnerability to climatic stressors like floods, interrogating their perceived vulnerability will contribute significantly to the climate change vulnerability discourse and how household vulnerability influences their coping and adaptation strategies. Also, ascertaining households' perceived vulnerability becomes critical as environmental perceptions are found to be among the key elements influencing the selection and adaptation strategies (Smithers and Smit, 2009, Codjoe and Afuduo, 2015).

The timely nature of this study cannot be overemphasized. Urbanisation is leading to an increased pressure on the urban poor who are likely to live in places most vulnerable to climatic stressors like floods. For example, Ghana is in its urban age. For the first time in its history, the proportion of the population living in urban areas is more than that in the rural areas (Yeboah et al., 2013, GSS, 2012). Unfortunately, the trend of urbanization has had a heavy burden, particularly on the urban poor living in vulnerable physical and human environments in major coastal megacities of Africa. There is, however, a paucity of information on the coping strategies used by the populace of these localities. This study identifies the coping and/or adaptation options of households living in these vulnerable localities. Findings of this study are essential for developmental planning as current climatic trends and rural-urban migration to vulnerable places are far from over.

This research employs primary household data and constructs a livelihood vulnerability index that combines indicators identified in the literature and those suggested by community members. This approach helps to avoid the pitfalls associated with indexes arrived using secondary data sources for assessments that may not apply to the study populations. Finally, the planning and execution

of effective or successful adaptation strategies by individuals, households and communities are incumbent on a thorough understanding of the different factors contributing to vulnerability and adaptation/coping strategies. This approach bridges the gap between community needs, priorities at the local level and policy process at the macro level (Burton et al., 2006).

1.4 Study objectives

Resource-poor urban communities along the coast in many developing countries already face daunting challenges to their livelihood and well-being. Climate change and variability exacerbate the increasing amount of floods experienced in many such communities. Accounting for the variability in the social and demographic characteristics in these communities, the specific objectives of the study are:

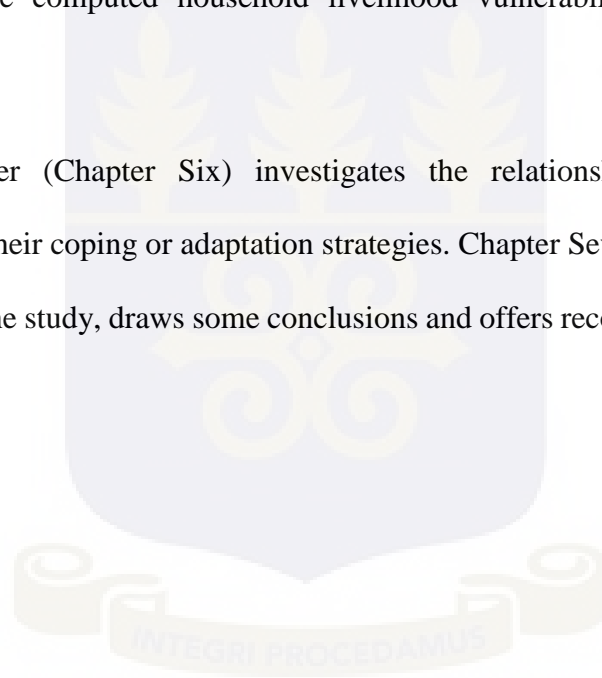
- i. To identify indicators for a household flood vulnerability index.
- ii. To compare the vulnerability of households in James Town with those in Agbogbloshie.
- iii. To investigate households' perceived vulnerability to floods.
- iv. To determine the relationship between computed and perceived households' vulnerability to floods.
- v. Examine the sociodemographic characteristics associated with households underestimating their vulnerability.
- vi. Examine the relationship between the components of vulnerability and household coping strategies.

1.5 Outline of thesis

The first chapter of this thesis has provided a background to the study, the research problem, the research questions, the study rationale and the research objectives. Chapter Two presents a review

of current scholarship on climate change vulnerability and adaptation. The chapter also discusses the selection of indicators for household vulnerability index and the conceptual framework for the study. For context, the third chapter provides a brief description of the study communities and outlines the quantitative methodologies employed for data collection, management and analysis. Chapter Four discusses the development of the vulnerability index. The analyses in this chapter result in the computation of household vulnerability index and consequently the vulnerability of the two study communities- James Town and Agbogbloshie. Chapter Five examines the relationship between the computed household livelihood vulnerability and their perceived vulnerability.

The penultimate chapter (Chapter Six) investigates the relationship between household vulnerability index and their coping or adaptation strategies. Chapter Seven is the final chapter; it provides a summary of the study, draws some conclusions and offers recommendations for further studies.



CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.0 Introduction

The epistemology of vulnerability, adaptation and coping in the climate change literature is still evolving. Their interpretations extend beyond issues of semantics but reflect on how climate change and variability researches are conceptualised and problems are addressed by policy makers (O'Brien et al., 2004). This chapter introduces the concepts of vulnerability, adaptation and coping strategies. It concludes with a selection of indicators of household vulnerability and the conceptual framework for this empirical study.

2.1 The concept of vulnerability

Ordinarily, the word 'vulnerability' denotes the ability of a system to be wounded. Thus, it carries with it the likelihood of a system exposed to a hazard. The various definitions of vulnerability seen in several scientific and policy essays capture the notion of damage and impact, possible loss, threat, risk and stress (Harley et al., 2008). Even further, the vulnerability of a system is sometimes alluded to as its lack of power and control within the specified situations or conditions. Vulnerability is also described as the "propensity or predisposition to be adversely affected" (Pachauri et al., 2014). Besides the IPCC's definitions of vulnerability other very widely used definitions of vulnerability are shown in Table 2.1.

Although the concept of vulnerability is still evolving, it hangs on two broad main considerations or viewpoints. Various researchers have conceptualized vulnerability either as

- i. An 'endpoint' or outcome phenomenon
- ii. As a 'starting point' or contextual situation.

Table 2. 1 Selected definitions of vulnerability

<ul style="list-style-type: none">▪ The susceptibility of a system to disturbances determined by exposure to perturbations, sensitivity to perturbations, and the capacity to adapt (Nelson et al., 2010)▪ The degree to which an individual, group or system is susceptible to harm due to exposure to a hazard or stress, and the (in)ability to cope, recover or fundamentally adapt (Tompkins et al., 2005)▪ The degree to which a community, population, species, ecosystem, region, agricultural system, or some other quantity is susceptible to, or unable to cope with, adverse effects of climate change (UNFCCC, 1992).▪ The extent to which climate change may damage or harm a system and depends not only on a system’s sensitivity but also on its ability to adapt to new climatic conditions”(Watson et al., 1998)▪ The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards (Reduction, 2004).▪ The susceptibility of a given population, system, or place to harm from exposure to the hazard and directly affects the ability to prepare for, respond to and recover from hazards and disasters (Cutter et al., 2009).
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Source: Author’s compilation, 2014

Endpoint or outcome vulnerability: The concept of endpoint vulnerability first brought to the fore by Kelly and Adger (2000), considers vulnerability as ‘the endpoint of a sequence of analyses beginning with projections of future emission trends, moving on to the development of climate scenarios, and thence to biophysical impact studies and the identification of adaptive options’ (p.

326). This approach represents vulnerability as the net impact of climate change and serves as a means of ascertaining the extent of the problem of climate change, thus providing some guidance for a policy with respect to the cost of climate change as against the cost of mitigation (Kelly and Adger, 2000, O'Brien et al., 2007). This idea of vulnerability is in sync with the definition given by the IPCC in its Third Assessment Report (TAR), which defines vulnerability as ‘the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes and sees vulnerability to climate change as a function of exposure, sensitivity and adaptive capacity (McCarthy, 2001). In relation to the endpoint view of vulnerability, adaptation options are considered as technological actions intended to minimize climate change impacts that have been projected (Shah et al., 2013).

Starting point vulnerability: The ‘starting point’ interpretation of vulnerability considers it as the social and ecological characteristics of a place or locale exposing it to the changing climate. Thus vulnerability assessments in this respect seek to identify ‘hot spots’ or the characteristics, causes and structures of a place shaping their susceptibility. This approach tends to identify policies and measures that reduce the vulnerability of a system and aims at increasing adaptive capacity. Succinctly, this approach defines vulnerability as the precursor state of systems because of an array of existing factors-political, economic, social etc. - that determines that system’s ability to respond to a climatic stress. In essence, vulnerability per the starting point interpretation posits that tackling the internal socioeconomic vulnerability will, in turn, reduce future vulnerability to climate change (Füssel, 2005).

2.2 Classical theories of vulnerability research

Three major frameworks have driven vulnerability research. These are the risk-hazard, social constructivist and the hazard-of-place frameworks. Natural hazards are physical occurrences with

adverse impacts on the ecosystem including humans and the environment. These events are said to be disasters when the hazard impact adversely on human systems and disrupt the social system on a material, psychological, or health basis (Hyndman and Hyndman, 2016).

Risk-hazard framework: This framework is employed frequently in disaster-risk management and disaster-risk research. The framework aims to ascertain risks¹ to expose units (value elements) resulting from exposure or contact with specific hazards. Exposed units may be different across different spatial locations. Hazards in this respect are considered as external influences of a potentially damaging physical event or occurrence, including human activity that may result in a loss of life and/or property damage (UN 2004). Within this framework, the concept of vulnerability is limited to the physical or biophysical properties of the system/systems under consideration. Thus vulnerability is said to be ‘internal biophysical vulnerability’ (Füssel, 2007a).

Social constructivist framework: Unlike the risk-hazard framework which is mostly concerned with the physical properties of a place, the social constructivist framework analyses the characteristics of individuals contributing to their level vulnerability at their locale. Emphasis is placed on the unique characteristics of individuals which make them adversely impacted by climatic hazards. This framework is in line with the ‘entitlement and livelihood’ constructs that characterises the multiple causes of single outcomes (Mearns and Norton, 2010). Basically, it says an individual is vulnerable because of his/her social, economic and political characteristics.

Hazard-of-place framework: This is considered an integrated approach framework. As an extension of the social constructivist framework for vulnerability, the hazard-of-place framework

¹Risk in this respect is considered as the “expected losses resulting from interactions between natural or human-induced hazards and vulnerable conditions” (United Nations, 2004).

factors considers both the biophysical elements and human or social factors. This framework considers overall vulnerability because of biophysical and social vulnerabilities of a place. The biophysical aspect focuses on the environmental processes causing the hazardous conditions. It also considers vulnerability as a pre-existing environmental condition, thus assessed by considering the proximity of humans to the hazard. Social vulnerability, on the other hand, argues that vulnerability is influenced by economic conditions, social relations, political power and other individual variables such as age and income or wealth (Watts and Bohle, 1993). The three distinct elements of this framework are the exposure assessment (identifying the source of risk) impact assessment (a consequence of climatic hazard) and damage assessment (Cutter et al., 2006). This integrated approach to vulnerability research is now widely applied in the context of global environmental change and climate change with particular reference to communities and/or other social units (Füssel, 2007b).

2.3 IPCC definitions of vulnerability

In its Second Assessment Report (SAR), IPCC defines vulnerability as the extent to which climate change may damage or harm a system; it depends not only on a system's sensitivity but also on its ability to adapt to new climatic conditions (Watson et al., 1996). The IPCC Third Assessment Report (TAR) posits vulnerability as a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and adaptive capacity (McCarthy, 2001). Vulnerability in the Fourth Assessment Report of the IPCC is consistent with that of the TAR.

Acknowledging the need to account for the long-term nature of the climate change and complexity of the hazards, the current definition factors in the idea of adaptive capacity and a 'regional exposure factor' (Füssel, 2007b). This makes the current IPCC definition of vulnerability to be in sync with the integrated approach/hazard-of-place concept of vulnerability (Füssel, 2007b, Cutter

et al., 2006). The glossary of the 5th Assessment Report of the IPCC further defines vulnerability as the ‘propensity or predisposition to be adversely affected’ and is a function of the sensitivity or susceptibility of the system to harm and the lack of capacity to cope or adapt.

2.4 Measures of vulnerability: a household vulnerability index

Vulnerability assessments follow three main approaches. These are the socioeconomic, biophysical and an integrated approach that combines both the sociodemographic and biophysical approaches. The socioeconomic approach emphasises the significance of variations in the socioeconomic characteristics contributing to the varying adaptive capacity of individuals and households or communities in different locations. Vulnerability is acknowledged as a starting point within systems before it encounters a given hazard (Kelly and Adger, 2000). The downside of this approach, however, is that it limits vulnerability to socioeconomic or political characteristics with minimal or no consideration of the frequency and magnitude of the biophysical elements at play. The biophysical approach in assessing vulnerability, on the other hand, seeks to determine the level of damage that a climate-related hazard causes on both social and biological systems. Findings from this approach albeit insightful prove not to adequately explain the very complex dynamics of vulnerability, particularly taking into consideration the central role of human agency in vulnerability and adaptation (Opiyo et al., 2014). Other scholars do succinctly allude to the fact that biophysical approach often emphasises extreme events while downplaying the importance of social processes that influence vulnerability (Opiyo et al., 2014, Liverman, 1990).

This research adopts an integrated approach (combined socioeconomic and biophysical approaches) which yields a household vulnerability index in synchrony with other empirical works. particularly studies by Opiyo et al (2014) and Hahn et al (2009). The household vulnerability index is computed from the summation of indices from seven major components:

sociodemographic profile, livelihood strategies, health, food, water and sanitation, and climate vulnerability (Hahn et al., 2009, Etwire et al., 2013).

2.5 The concept of adaptation

The concept of adaptation is not a preserve of the climate change literature, but rather has had a long multidisciplinary history in different fields of study. Thus, it embraces a wide range of meaning across different fields. The term adaptation is thought to have had its origins in evolutionary biology where it is considered as the development of the genetic or behavioural characteristics by an organism or system to enable it to cope or adapt to environmental changes for the purposes of survival and reproduction (Winterhalder, 1980, Denevan, 1983). Examples of adaptation are seen in the modification of a behaviour that allows an organism to better evade predators, a protein functioning better at body temperature, or an anatomical feature that allows an organism to access a valuable new resource. Thus, an essential concept considered in adaptation is the change of state or conduct of an organism or system in response to an observed change in its environment.

Appropriating the above concept, ecologists like Julian Steward coin the term ‘culture adaptation’ to mean adjustment of the ‘culture core’ of individuals and societies to the natural environment through subsistence activities, with the intention of survival and /or improving well-being (Butzer, 1989). Some anthropologists and archaeologists consider the process of adaptation as a result of selecting acting variation through cultural practices (Smit and Wandel, 2006).

In this consideration, cultural practices are considered as adaptation features only when the practices or actions result in the survival or improvement of the living situation of the populace. Juxtaposing the social concept of adaptation with that of the natural sciences, a cultural practice of a group which is unable to cope with the environmental stress to ensure survival does not lead to

adaptation (Butzer, 1989). An important aspect in the field of adaptation is the demonstration of how systems employ their capabilities – household, social, political and economic processes or characteristics – to shape the existence in the presence of an external stressor. The external stressor in this respect could be any climatic event or occurrence which has the potential to affect or cause a system to function differently.

2.6 Adaptation and coping strategies associated with climate change/variability

Humans have long been adapting to climate change and variability in diverse ways such as migrating from habitats experiencing harsh environmental conditions, altering agricultural patterns and changing livelihood strategies (Burton et al., 2006). Historically human have seemingly been successful in adapting to changes in the climate. However, the records of collapsed communities reveal that coping and /or adapting to climate change has got its limits (Dow et al., 2013, O'Brien, 2009).

Climate change adaptation can be described as the process, action or outcome that occurs in a system with the aim of making better the system's ability to cope, manage or adjust to altering conditions, stress, hazards, risks or opportunity resulting from climate change and /or variability (Smit and Wandel, 2006). The IPCC defines adaptation as 'the process of adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities' (IPCC, 2012a). The United Nation Framework Convention on Climate Change also defines to adaptation as 'adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts (UNFCCC, 2005). Central to the above definitions and many explanations of climate change adaptation is the principle of adjustment(s) by a system to either an observed or expected changes in the climate (Adger et al., 2005). The employed adjustments may refer to changes in the

processes, practices, and structures of the system to moderate potential damages or to benefit from opportunities associated with a climate change. Other definitions of adaptation in the climate change literature are shown in Table 2.2.

In 2007, at Bali, scientists and policy makers collectively agreed at the Thirteenth Conference of the Parties (COP13) of the United Nations Framework Convention on Climate Change (UNFCCC), that ‘climate change adaptation’ be considered as a major building block (along with mitigation, finance and technology) required for a strengthened future response to climate change.

2.6.1 Types of climate change adaptation

Individuals, communities and national governments do embark on adaptation for a myriad of reasons, ranging from economic well-being to the improvement of safety (Adger et al., 2005). These initiatives are achieved in diverse ways such as the construction of physical structures or market exchanges or the extension of social capital (Adger et al., 2003, Smit et al., 2000). Adaptation measures are usually classified based on the timing, approach, goal and scale with which the measure or strategy is being implemented. Additionally, adaptation measures can also be described based on the sector within which strategies are rolled out.

Table 2. 2 Sample definitions for climate change adaptation

<ul style="list-style-type: none"> ▪ <i>The process of adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities (IPCC 2012).</i> ▪ <i>Adaptation refers to as the adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts (UNFCCC 2005)</i> ▪ <i>Adaptation involves adjustments to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well climate change (Smit, 1993).</i> ▪ <i>Adaptation to climate change includes all adjustments in behaviour or economic structure that reduce the vulnerability of society to changes in the climate system (Smith et al. 1996)</i> ▪ <i>Adaptability refers to the degree to which adjustments are possible in practices, processes, or structures of systems to projected or actual changes of climate. Adaptation can be spontaneous or planned and can be carried out in response to or in anticipation of a change in conditions (Watson et al. 1997).</i> ▪ <i>Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploit beneficial opportunities (EPA 2005)</i> ▪ <i>Adaptation is the process or outcome of a process that leads to a reduction in harm or risk of harm, or realisation of benefits associated with climate variability and climate change (UKCIP, 2003).</i>
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Source: Author's compilation, 2015

When dimensions of time, goal and intention of adaptation are taken into consideration, the measure could be termed as being reactive or anticipatory. Reactive adaptation describes actions taken in view of earlier observed or experienced impacts of climate change. On the other hand, anticipatory adaptation actions are taken before expected impacts become obvious. The latter

(anticipatory adaptation), therefore seeks more to moderate the effect of climate change by improving exposed population's ability to respond to impact (Adger et al., 2005).

Depending on the scale, autonomous adaptation is considered to take place independently as a reaction to changes that are occurring in the climatic system without a public agency intervention (Smit and Pilifosova, 2003). This occurs spontaneously depending on the needs of an individual or group and based on the capacities of a given sector of the society. Planned adaptation, on the other hand, represents deliberate processes and/or actions undertaken to reduce the risks and capitalise on the opportunities associated with global climate change (Füssel, 2007b). Planned adaptation actions are decisions made with a clear awareness that there is a change in prevailing conditions which is triggered or exacerbated by climate change. Generally, a major difference in adaptation practice and approach is also based on the sequence or flow of involvement; as to whether it is a top-down or bottom-up approach.

2.6.2 Coping strategy

Coping and adaptation strategies have often been used interchangeably. Generally, coping strategies have been used more to represent a short-term and immediate response to climatic hazards. This phenomenon is skewed towards an immediate action taken to ensure survival more than to build resilience. Consequently, coping strategies may prove useful for a short-term but often inefficient in addressing the reality of recurring exposure to climatic hazards.

While coping has been considered a form of an adaptation strategy, but short-term in nature, it often has very little consideration of future events. Coping strategies undertaken could result in maladaptation in future as much consideration for future scenarios may be overlooked. The above, notwithstanding, coping strategies may be inevitable as individuals, households or communities continue to face the challenges or hurdles involved in pursuing sustainable adaptation options.

Summary of what adaptation and coping strategies are

The many different definitions of adaptation and coping strategies or options indicate the different opinions held when explaining the cause and consequence of current global environmental change. Whereas changes in the environment are a result of changes in the geosphere/biosphere due to global emissions of greenhouse gases, the impact of climate change and variability are felt differentially at local or regional levels due to a sum of dominant other local non-climatic factors. Definitions of ‘adaptation’ and ‘coping’ are therefore influenced very much by how one explains the current global environmental change.

Also important is the fact that the concept of adaptation embraces a wide range of policies and activities primarily intended to reduce the risks posed by climate change and variability. This encompasses both realised and expected risks; thus, the expectations of different multinational agencies and organisations influence the way adaptation to climate change is explained and defined. For example, Ayers (2010), contests that a focus on climate impacts leads to a focus on the population exposed to a climatic hazard while a focus on addressing vulnerability brings to the fore the ‘poorest’ as the most ‘vulnerable’ as the main target group.

Two major inquiries that have also influenced the definitions of adaptation and coping strategies are:

- i. Who are the adaptors?
- ii. What are they adapting to?

Answers to these questions are widely embedded in how overarching terms like vulnerability and risk are explained and understood by influential organizations such as IPCC, UNFCCC and UNDP.

2.7 Flooding in Accra, Ghana

Flooding is referred to as ‘the inundation of an area by unexpected rise of water level by both dam failure or extreme rainfall duration and intensity in which lives and properties in the affected area are under risk’. That flooding has had a greater impact compared to other disasters in Accra is hardly contested. Since the early 1930s, Accra has recorded notable floods (Karley, 2009). Subsequent flood related disasters were recorded in 1955, 1960, 1963, 1973, 1986, 1991, 1995, 1999, 2001, 2002, 2010 and 2011 (Twumasi and Asomani-Boateng, 2002, Karley, 2009, Rain et al., 2011b).

There exist a dynamic and complex system in coastal environments like that of Accra that leads to frequent flooding. Current scholarship reveals three broad interrelating factors that lead to flooding. These are (a) Climate variability – Rainfall and storm surges, (b) Hydrological relative to impervious urban landscape and (c) Management of water resources and other human activities (Amoako and Frimpong Boamah, 2015).

2.7.1 Climate variability and flooding in Accra, Ghana

Although flooding has been occurring on many occasions in numerous countries over the years, the recent increase in frequency and intensity can partly be attributed to the changing global climate (Schanze et al., 2007, Brouwer et al., 2007, Few, 2003). The visible impact of climate change is seen across Ghana, and the coastal savanna region is no exception (Government of Ghana 2015: TNC)

Analysis of climate change in the coastal savannas region of Ghana shows a reduction in the amount of rainfall/precipitation received within Accra but higher variability in climatic elements, particularly the frequency and intensity of rainfall (Owusu and Waylen, 2009, Nkrumah et al., 2014, Kankam-Yeboah et al., 2011).

Rainfall records for 20 years (1980 -to 2010) for Accra showed a variable rate of change in observed precipitation/rainfall. Table 2.3 shows analysis of projected return period of rainfall in Accra. A maximum of 84.05 mm in 1 day, 91.60 mm in 2 days, 100.40 mm in 3 days, 105.67 mm in 4 days and 109.47 mm in 5 days is expected to occur in every 2 years (Kwaku and Duke, 2007). These return period maximum rainfall figures give an indication of extreme precipitation events in Accra (Amoako and Frimpong Boamah, 2015), which compounds the likelihood of flooding. In other words, the region experiences heavy rains in shorter durations. Current climate variability reflects variations in the magnitude(depth) and timing (duration) of rainfall event leading to an increase in flooding in Accra, Ghana (Kwaku and Duke, 2007). This is because the surface runoff generated by high-intensity short-duration (HI-SD) rainfall/storms in Accra which can be attributed to climate variability often exceeds the infiltration rates and the amount of water existing drainage systems can take (Alfa et al., 2011).

Table 2. 3 Projected annual 1 day, 2–5 consecutive days’ maximum rainfall for Accra

Return period	1day (mm)	2 days (mm)	3 days (mm)	4 days (mm)	5 days (mm)
2	84.04	91.60	100.40	105.67	109.47
5	121.54	130.27	144.57	153.12	157.47
10	147.10	156.31	174.60	185.52	190.07
20	171.60	181.08	203.32	216.61	221.23
50	205.44	215.04	242.94	259.61	264.20
100	230.97	240.49	272.77	292.07	296.54

Source: Extracted from Kwaku and Duke (2007).

Additionally, increases in temperature have resulted in increased sea level due to thermal expansion (EPA, 2003). The rate of sea level rise in Ghana is estimated at a rate of about 2 mm/yr (Addo et al., 2008, Ibe and Quelennac, 1989). Observable sea-level rise leads to a spatial shift of coastal geomorphology which often leads to a redistribution of coastal landforms (Crooks, 2004)

that leads to instances of flooding particularly in low-laying coastal communities. Also, a comprehensive flood risk analysis reported by Ghana's Third National Communication Report to the UNFCCC (2015) identified climate variability reflecting in moderate to severe precipitation as the primary cause of flooding in Accra. This assertion is corroborated by the Ghana Meteorological Agency (GMET) report which states that '*Accra experiences a bimodal rainfall regime, which occurs from March to July (major rainy season) and from September to November (minor rainy season). Average annual rainfall is about 810 mm. Rainfall is usually intensive with short storms, giving rise to annual local flooding where drainage channels are missing or obstructed*'.

2.7.2 Other factors contributing to Flooding in Accra, Ghana

The built environment

Accra has seen massive infrastructure growth (GSS, 2012) in the city resulting in an increase in the total surface area of impervious surfaces preventing the infiltration of water in the soils. Increasingly buildings, roads, car parks, etc. have taken over existing vegetation cover which slows down run-off (Jha et al., 2012). This condition facilitates flooding especially amidst the already poor drainage networks (Yeboah, 2000). Also, there are instances where some infrastructures have been poorly situated, especially across waterways thus impeding the smooth flow of water after little or heavy rainfall.

Silted river courses and gutters

Although Accra is approximately 92 feet above sea level some communities are in much lower plains. During the raining season, rivers like the Odaw River overflows its' banks causing flooding in communities such as Dzowulu, Avenor and the communities for this research. Unfortunately, these low-lying communities have also seen an uncontrolled trend in infrastructural development.

Sanitation

Managing the solid waste generated in most urban sub-Saharan cities like Accra continues to be a challenge for most city managers (Kapepula et al., 2007, Okot-Okumu and Nyenje, 2011). Waste collection and management are particularly challenging in poor urban communities where inhabitants periodically have to cope with large depots of uncollected refuse which eventually end up in drains (Oteng-Ababio et al., 2013). The debris collected in gutters, especially when physical structures are built close to the water or drainage channels create flooding situation even with the least rain.

2.8 Overview of selected vulnerability studies in Ghana

There are a considerable number of studies that have examined the vulnerability of a place or household and adaptation and /or coping strategies to climate change and variability. Engaging various methodologies and frameworks of vulnerability and adaptation, studies have provided some insights into the socio-cultural and demographic as well as biophysical characteristics that turn to mitigate risk and/or influence vulnerability (Armah et al., 2010, Antwi-Agyei et al., 2012). The process and degree of vulnerability have been found to occur at different scales and disproportionately experienced even at the community level (Westerhoff and Smit, 2008). Individual perception and gender issues with respect to climate change and related adaptation strategies have also been explored and documented (Lolig et al., 2014, Codjoe et al., 2012, Fosu-Mensah et al., 2012). Other studies like Danso and Addo (2016) and Gyampoh et al (2009) have identified some coping strategies employed by households facing flooding situations (Danso and Addo, 2016).

Although findings from the various methods used for vulnerability assessments do have significant implication for the success of designed coping and adaptation strategies for any intervention, no study was found exploring the correlation between individual perceived vulnerability measures

and computed vulnerability. Also, no study examined how the vulnerability of various household influences their selection of coping or adaptation strategies. The remaining section of the literature review discusses the selection of indicators of household vulnerability and conceptual framework for this empirical study.

2.9 Selection of indicators for household vulnerability to floods

Vulnerability to climate change is a multidimensional concept determined by a complex inter-relationship of multiple factors. Despite the fact that many variables used to represent the components of vulnerability are not directly quantifiable, computing a vulnerability index is useful for comparison of similar systems (Piya et al., 2012). Several indicators have been suggested to influence the vulnerability of a system –individual, household or community to climate-related hazards. The choice of an indicator is guided by theory, data available or both (Vincent, 2004). Driven by relevant theory on the vulnerability of resource-poor communities and in concurrence with available data, indicators of vulnerability are selected for the creation of a household vulnerability index.

A notable approach employed in selecting indicators of household vulnerability is the Sustainable Livelihood Approach (SLA) (Chambers and Conway, 1992). Traditional the SLA considers the five livelihood assets; natural, social, financial, physical, and human capital. Although these have proven useful in assessing the ability of households to withstand shocks such as epidemics or civil conflict, climate change adds to the complexity of the household security. Hahn, et al (2009) alludes to the weakness in the SLA in addressing issues of sensitivity and adaptive capacity and posits a framework that distinctly identifies indicators of adaptive capacity and sensitivity. This study advances a livelihood vulnerable approach by Hahn et al (2009). The Livelihood Vulnerability Index based on Hahn et al (2009) comprises of seven major components –

sociodemographic profile, livelihood strategies, social network/capital, health, food, water, climate variability. In line with the IPCC definition of vulnerability, the seven components of the livelihood vulnerability index are then aggregated into (A) Adaptive Capacity-Socio-demographic profile, livelihood strategies and Social Network/ capital (B) Sensitivity- Health status, Water and Food situation and (C) Exposure- Climate Hazard.

The remaining sections of this chapter discuss the selection of household indicators of vulnerability under the various major components of vulnerability, the survey questions administered used to capture selected concept of vulnerability and their associated limitation. These factors or indicators selected contribute to vulnerability by either undermining the capacity for self-protection, diminishing access to social protection, delaying recovery from exposure to climatic hazards and increasing the susceptibility of households in a specific area or their general well-being (Notenbaert et al., 2013, Nkondze et al., 2013). Table 2.4 shows a summary of indicators selected.

2.9.1 Sociodemographic profile

The sociodemographic of the populace of any community usually position them to anticipate population situations (CEPAL, 2002). While individuals' sociodemographic characteristics can influence their capacity to cash in on some opportunities resulting from the change in climate; those same characteristics might lead to an increased risk of associated negative effect the climate. The heaviest toll of current change in climate will with a high certainty be among the most socio-demographically and economically underprivileged individuals like the poor and the aged (Parry et al., 2007).

In this study, the identified sociodemographic characteristic (profile) modulating the degree to which a household may withstand the climatic hazard; flood, were; age, sex, formal education,

building material, and well-being. The characters of the household head are used as a proxy for some of the sociodemographic characteristics of the household.

Age

The impact of climate change brings heightens the vulnerability of older people since it exposes them to extreme weather events and climate-sensitive vector-borne diseases. The general discourse on the nexus between climate change and health suggests that the greater health effects of the changing climate on older people may be the result of their greater physiological susceptibility and social vulnerability to climatic hazards (Filiberto et al., 2009). Hazards such as floods associated with climate change exacerbate the negative health impact on the elderly due to their physical decline or mere frailty (McGeehin and Mirabelli, 2001). It is reported that of the 35,000 early deaths recorded during the 2003 heat wave in France, there was an excess mortality of 70 percent of individuals between 75-to 94 years (Pirard et al., 2005).

The study considers households with heads above 60 years old and above as more vulnerable compared to households with younger household heads. The questionnaire was administered to household heads. They were asked, *how old are you?*

Potential limitation: Since the ages given were not verified with their birth certificates, there were the tendencies for either understating or exaggeration of the ages.

Gender

As the impact of climate change becomes clearer, the gender dimension gains more significance. Recent gender and climate literature speak more about the concept of poverty, which is pronounced more among female-headed households. Increasingly female-headed households have been shown to be disproportionately affected by climatic hazards.

First, besides limited physical capacity, the vulnerability of female headed household could be attributed to overwhelming family burden (Steeg et al., 2013). Secondly, women have a higher mortality rate during climate-related hazards such floods and droughts, and thirdly because women are more environmentally conscious (Arora-Jonsson, 2011, Ruth, 2009). This was depicted in Bangladesh during the 1991 major floods. Overall mortality was highest among women above the age of forty years (Bern et al., 1993). Also, women accounted for approximately 61% of mortalities caused by Cyclone Nargis in Myanmar in 2008 (Bern et al., 1993). The sex of the household head (since being the one interviewed) was simply noted by the interviewer.

Potential limitation: There could be some ambiguity with who should be considered as the household head in households with multiple families or an absentee husband.

Education

Being educated can influence ‘one’s risk perception, skills and knowledge and indirectly reduce poverty, improve health and promote access to information and resources’ (Muttarak and Lutz, 2014a). Men and women without education are seen to be remarkably more vulnerable to the impact of climate change (Lutz et al., 2013). Educated individuals, households and societies show improved adaptive capacity in the event of climatic hazards and also recover faster (Muttarak and Lutz, 2014a). In landmark studies conducted in El Salvador, Wamsler (2011) found out that average levels of education were significantly lower for households with a high risk of adverse climatic conditions (Wamsler, 2011). The study showed that the level of education had a direct effect on the characteristics that reduce risk and a mitigating effect on aspects that increase risk. This information was collected by asking household heads the levels of education of all the household members.

Potential limitation: Although formal education corroborates with knowledge of climate change, its impacts and adaptive capacity, specific local knowledge and experiences could modulate its effectiveness on the adaptive capacity of the household.

Household's building material

Vulnerability can be considered as the expected degree of loss for an element at risk because of a certain event. Vulnerability (physical vulnerability) of households depends, among many, on the type of building material a house is made of. Thus, household building materials with decreased potential to withstand the impact of flooding were considered more vulnerable.

Households with plywood walls and wooden floors are seen to be more vulnerable to floods compared to those with brick or block (Sagala, 2006). During the data collection, the type of building material used to construct the household's building or house was observed and noted.

Potential limitation: How to categorise a house built with different types of building materials.

The well-being of household

A candid measurement of vulnerability will require taking into account other dimensions of well-being that are adversely affected by climate change while acknowledging the personal, environmental and social factors involved in translating exposure to climatic hazards into losses in well-being (Lindley et al., 2011).

Traditional resource measures such as income are a means to an end are used for different things in the event of a climatic hazard such as floods. Although the employment of interpersonal comparisons of utility, which capture welfare, attributes, experiences as well as observable choices of an individual is still contested (List, 2003), there is growing agreement that for the purposes of social policy, interpersonal comparability is indispensable (Wolbring et al., 2013). Taking a cue

from theoretical underpinning from the works of Van Praag (Van Praag, 1968, Van Praag and Ferrer-i-Carbonell, 2008, Van Praag and Kapteyn, 1973), this study employed a novel approach to investigate individual's subjective qualification of household well-being in the face of varying degrees exposure to climatic hazards. Household heads were asked to evaluate their income range he/she considers 'excellent,' 'good,' 'sufficient,' 'inadequate,' etc. (Van Praag, 1968, Van Praag and Ferrer-i-Carbonell, 2008, Van Praag and Kapteyn, 1973). Computation of a *want parameter* is then calculated.

Potential limitation: Although reliability and validity of this measure proven, it carries with the challenges associated with subjective measures.

2.9.2 Livelihood strategies

Although inadequately discussed in the climate change and vulnerability discourse, the 'employment' component is very important. Ahmed (2015) justifiably states that 'no-one should expect that poor and marginalized citizens will adopt more "climate-friendly" behaviour while they are lacking their basic rights' (Ahmed, 2015). Basically, unemployment buttresses climate vulnerability of the poor or marginalized

Household employment status

Besides the types of employment one engages in, individual and household vulnerability is influenced very much by the employment status (employed vs. unemployed) of members of the household. Being employed can help build resilience to climate risks by (i) facilitating the development of safety nets and (ii) providing the necessary income to improve adaptive capacity.

Potential limitation: The survey questions were limited to the primary source of income thus could miss other potential sources of livelihood. Also, the livelihood of other non-residence members of the household family that remit to the household not captured.

2.9.3 Social Network/capital

The capacity of individuals and households in a community to withstand climatic hazards like floods is inherently interlinked with the collective support system shown in that community by friends and family (Adger et al., 2003). The seminal work of Putnam situates social capital in the contest of values and norms of trust and reciprocity and assets which manifest in social relationships (Putnam, 1995). Naturally, stronger social ties have been associated with better chances of survival or coping with natural disasters (Pelling, 2012). For example, it has been reported that households having larger networks receive monetary and material support from more people, explaining the positive impacts on their recovery from a natural hazard like an earthquake (Tse et al., 2013). Social capital has also been noted to help build resilience both at the household and community level (Othniel et al., 2013)

Questions asked to solicit for the social capital of household were

- i. Whether or not they received any form of support (kind/cash) over the past one month prior to the survey and whether any member of the household has given support (Kind/cash) to someone outside the household over the same period and
- ii. Whether or not a household can be sure of receiving help in times of need.

Potential limitation: Reliance on the self-reported type of help/support has in it the subjectivity of how help or support is translated by an individual.

2.9.4 Health

Climate change has been associated with both non-communicable and infectious diseases (Portier et al., 2013). Climatic factors like temperature, humidity, precipitation and extreme weather events do directly or indirectly affect the prevalence of diseases. Specifically, floods have been associated with increased incidence of conditions like malaria and diarrheal diseases. Also, there is an increased rate of injuries observed before the onset, during and after floods (Torti, 2012). The treatment of these diseases conditions and injuries are incumbent on the availability of health centres or hospital to attend to flood victims.

Assessing the health vulnerability enables one to understand households and individuals in conditions or jurisdictions that are more susceptible/sensitive to health conditions that are climate sensitive (Manangan et al., 2008). Household health variables identified and investigated to be sensitive to floods were:

Malaria prone index: Malaria is a notable climate-sensitive vector-borne disease of public health significance, particularly in resource-poor flood prone communities. Ghana is among the top ten countries in the world with the highest malaria morbidity rates and even more worrying among the top 15 countries with the highest malaria mortality rates (WHO, 2014b).

Floods have long been associated with malaria incidence as the former increases the conditions suitable for the breeding of the malaria vector, mosquito (Ding et al., 2014). Being malaria endemic localities, the presence of mosquito-proof screens/nets was checked as a proxy for malaria prevention. Several studies have shown the benefits of mosquito proof screens/nets in the prevention of malaria (Habluetzel et al., 1997, Adongo et al., 2005, Larsen et al., 2014).

Potential limitation: Household members are still prone (though significantly less) to mosquito bite outside their houses.

Diarrhoea prone index: The evidence showing that flooding, particularly in resource –poor environments leads to an increased incidence of diarrhoea and diarrheal diseases is conclusive (Ding et al., 2013). Most diarrhoeal causing pathogens are transmitted through contaminated food and water. Food and water safety are usually compromised during flooding especially in poor sanitation areas (Podewils et al., 2004). Contaminated drinking and washing water and poor sanitation, together with inadequate sewage treatment in these poor-resource communities, often lead to life-threatening diarrhoeal diseases like cholera, typhoid and dysentery (Du et al., 2010). Several studies conducted in some other poor urban communities including one conducted by Mummuni (2013) conducted also in current study communities, predicts an increase in the incidence of diarrhoea in households due to floods even after controlling for demographic and socioeconomic factors (Mummuni, 2013, Rain et al., 2011a, Songsore et al., 2009).

Household heads were asked about the incidence of diarrhoea over the past month prior to data collection as an indicator for diarrhoeal vulnerability during floods. The household's experience of diarrhoea over the past one month was used as an indicator of diarrhoeal vulnerability or as a diarrhoea prone index during flooding.

Potential limitation: Although the likelihood of diarrhoeal episodes not related to sanitation conditions that are exacerbated by flood may be minimal, that possibility exists. Although diarrhoea was defined for the purposes of this study, relying on self-reported cases of diarrhoea can be inaccurate.

Time household members take to nearest health centre

Considering that disease incidence, physical injuries and fatalities do increase during flooding events, the farther a household is from health centre or hospital, the more vulnerable household

members are to the climatic hazard. Health centres are the primarily at the forefront to prepare and respond hazards during and after floods.

Generally, increased distance from health centres has been associated with increased risk of death after emergencies (Nicholl et al., 2007). A study in rural Ethiopia indicated that when children lived more than 1.5hrs from a health centre, they had between 2-to 3 fold risk of death compared to their counterpart that lived closer (Okwaraji et al., 2012)..

Table 2. 4 Major component and indicators of household (H) vulnerability

Major component	Sub-component / indicators
Sociodemographic profile	H head above 60 years Female-headed HH H members with no primary education H with building material, not brick/cement Household <i>want parameter</i>
Livelihood strategies	H members not employed H heads with no occupation
Social capital	Average receipts: give ratio H cannot rely on receiving support
Health	Time taken to the nearest hospital/health facility H with diarrhoea cases over the past month H with no windows covered with mosquito-proof screens/net
Water and sanitation	H with no indoor pipe or improved water source H without daily supply of water H without improved toilet
Food	H did not have enough food to eat in a day or more over the past month Average number of full meals taken by HH members
Climate variability	Experience flood in neighbourhood H affected by flooding

Source: Compiled by Author, 2015

This situation will obviously be worsened in the event of floods. Households were asked about the average time taken to reach the nearest health post/hospital as a component of health accessibility (Gerlitz et al., 2015, Hahn et al., 2009)

Potential limitation: Since this variable was not accessed by the actual time with a clock, subjective estimates by household could be either under/overestimated.

2.9.5 Food

Increase intensity and frequency of drought, floods and storms are associated with food insecurity. These climatic hazards have led, on countless times, to the destruction of crops which affects influencing food production and livelihoods. Climate change affects all four dimensions –food availability, accessibility, affordability and utilization – of food security. With a baseline of no climate change, studies such as Fisher et al (2002, 2005) estimates that climate variability could bump-up the number of undernourished people in 2080 by about 5-to 26% (Fischer et al., 2005). Besides climatic hazards like flooding and drought destroying crops of households engaged in agricultural related activities, this phenomenon results in increased prices of food. These conditions make the already poor in the society more vulnerable.

The direct effect on food production may not be as severe as the general impact on the socioeconomic that in turn to affect the affordability and/or accessibility of foods (Schmidhuber and Tubiello, 2007). Thus, general flooded areas often harbour several factors that do lead to high levels of food insecurity and malnutrition of the affected populace. Generally, flooding leads, particularly the poor to have both reduced quantity and frequency of meals with deteriorated quality (Parvin et al., 2015). To determine the sensitivity of household food situation to the climatic hazard flood, the following were ascertained.

i. Household not having food to eat:

Household heads were asked whether they did not have enough food to eat on any day over the past month. Household already experiencing inadequate food consumption are considered more vulnerable to the floods as the latter exacerbates existing conditions of food security.

Potential limitation: The concept of 'Enough' although explained is still subjective. Also, no specification regarding seasonality effect on food factored.

ii. Average number of full meals taken in a day

The average number of full meals consumed by a household was also determined. Household consuming less food in terms of frequency were more likely to consume much lower in the wake of flooding hence more vulnerable.

2.9.6 Water and sanitation

The water and sanitation situations of communities and regions are very sensitive to current change in climate. For example, a higher temperature and increased rainfall, or seawater levels do affect the availability of water and sanitation facilities of households and communities (Howard and Bartram).

Water scarcity and safety is already a problem in many developing countries (Fedoroff et al., 2010). Water is forecasted to be an important channel through which the impact of climate change will be heavily felt (Bates et al., 2008). Already, the unavailability of safe-drinking water and sanitation facilities causes three million premature deaths in rural areas in developing countries alone (Water, 2009). The advent of climatic stressors like floods and drought compromises the water and sanitation infrastructure in a place, making the populace more prone to water borne diseases and runoff from industrial effluents and agricultural pesticides (Bates et al., 2008). The

source and availability of water for the households in the study area were inquired for measures of sensitivity to climate change.

Improved water source

Households with a water source adequately protected from contamination from external sources were considered to have had an improved water source. The WHO/UNICEF monitoring Programme for Water Supply and Sanitation (JMP) provides examples of water sources that can be considered as coming from an ‘improved’ source as pipe borne water, public tap or standpipe, protected spring or well and rainwater (Bartram, 2009). Households without such improved water sources are more sensitive to climatic hazards such as floods as contamination to other sources of water are more likely during flooding.

Potential limitation: There could be some ambiguity with respect to the primary actual source of water when a household has multiple sources of water supply.

Daily supply of water

Besides the accompanying health impact of contaminated water resulting from flooding, high-velocity floods can damage water delivery systems. In some extreme cases of flooding, the accessibility of water is also compromised. Data were collected on whether households had a daily supply of water as a proxy for their sensitive to water supply during floods.

Household sanitation

Increased precipitations resulting in flooding do put pressure on week sanitation systems resulting in an outbreak of diarrhoeal and other diseases. The indication of vulnerability to floods is more visibly related to the performance of sewers, wastewater treatment works, septic tanks and pits (Howard and Bartram, 2010).

This research computed a household sanitation based on the type of toilet facility the household uses and method of waste disposal. Flush toilet, piped sewer system, septic tank, flush/pour flush to a pit latrine, ventilated improved pit latrine (VIP), pit latrine with slab, and composting toilet is considered as ‘improved’ sanitation facilities. Other forms of toilet facilities including shared facility were considered as ‘unimproved’ and increases households’ vulnerability.

Potential limitation: The state of functioning ‘improved sanitation facility’ was not assessed. Gaining such information might aid in the actual categorisation of an improved facility or unimproved facility.

2.9.7 Climate variability

The climate- related hazard considered in this study is flooding. Questions were asked to determine

- i. If a household had experienced flooding in their neighbourhoods
- ii. How a household was impacted directly by floods.

Other indicators of climate variability like temperature were not determined and considered in the study areas.

Potential limitation: Overall vulnerability may be influenced by other climate related hazards not factored in this work. However, several studies have identified flooding as the main and most experienced climate related hazard faced in the study areas of this research.

2.10 Conceptual framework for assessing vulnerability and its relationship with coping/adaptation strategies

Hahn et al, 2009 identified six major components of households’ vulnerability to floods. These are sociodemographic profile, livelihood strategies, social network/capital, health, food, water and climate variability. Through a systematic review of the literature, this study has identified a water

and sanitation as an extra major component of households vulnerability, particularly with respect to resource-poor urban communities. (Lamichhane, 2010, Hahn et al., 2009).

Despite challenges associated with the use of indicators, they tend to help quantify or give value to a problem and provide robust data, particularly for decision-makers when comparing different scenarios or places. Employing an indicator approach to climate change vulnerability assessment also provides a structured methodology for monitoring projects or interventions intended to address the problem. Although indicators selected to represent a dimension of vulnerability to floods may be contested, selected indicators were deemed relevant particularly to study sites. Selected indicators were also influenced by the availability of data required and it's being relatively affordable to collect. One critical requirement for inclusiveness of an indicator is its replicability. Indicator approach to vulnerability assessment allowed the study to choose from a wide range of socioeconomic, climatic and geophysical determinant of vulnerability (Fernandez et al., 2015).

The Sustainable Livelihood approach has been employed in evaluating the capability of households to withstand shocks or hazard such as epidemics or civil conflict (Krantz, 2001, Masanjala, 2007, Gibson, 2006, Ferrol-Schulte et al., 2013). This approach has some strength in addressing issues of the sensitivity and adaptive capacity of households. However, to evaluate fully the livelihood risk of climate change and variability, there is a need to adequately factor in the climate related exposure or hazard in question (Hahn et al., 2009). Advancing on integrated approaches suggested by several studies (Hahn et al., 2009, Nkondze et al., 2013, Etwire et al., 2013, Salik et al., 2015), this researcher is guided by an integrated framework (**Figure 1**) very much in sync with the IPCC definition of vulnerability; a function of exposure, sensitivity, and adaptive capacity (IPCC, 2001). The system or unit of analysis under consideration in this study is the household.

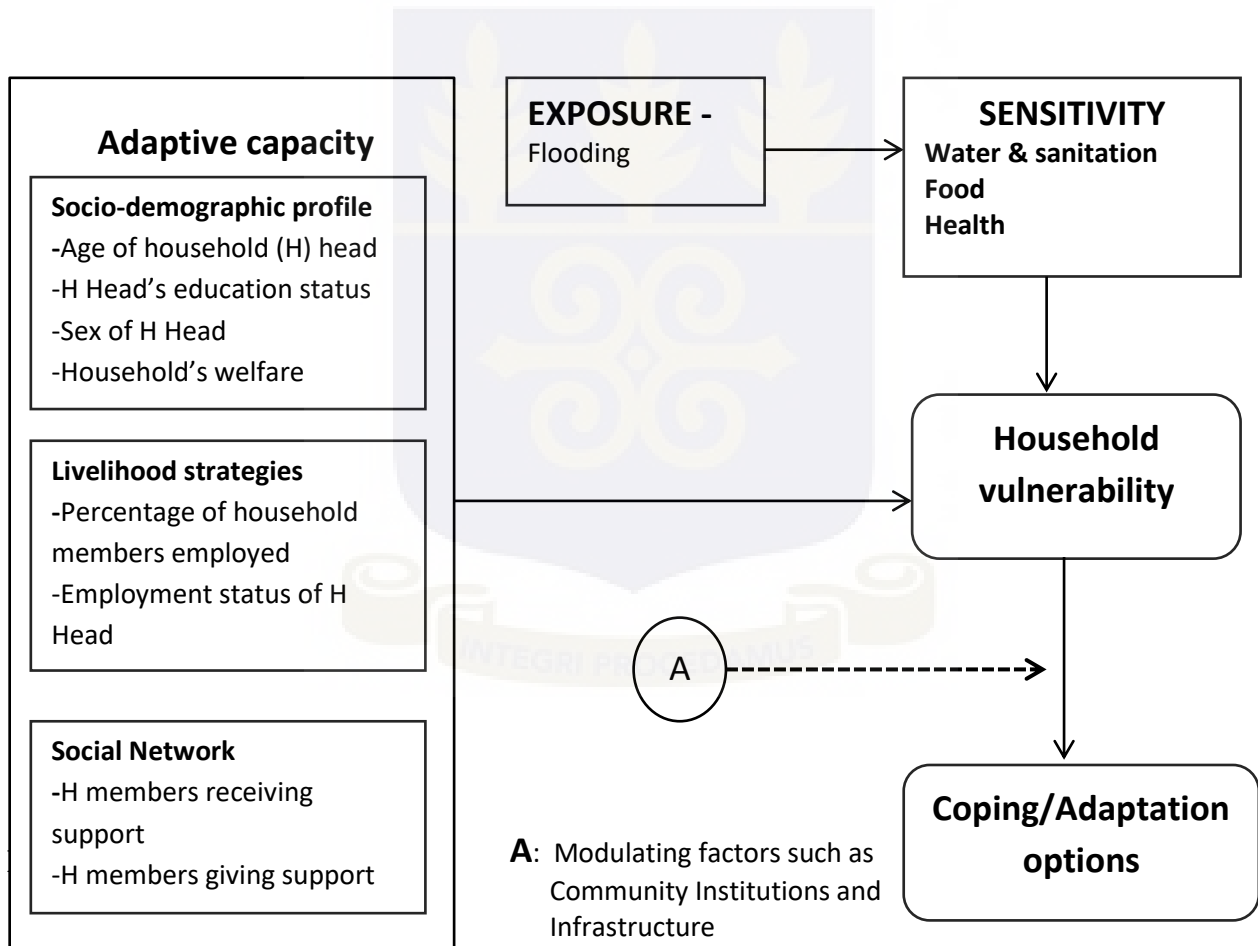
Exposure: The exposure element considered was flooding. That is the nature and degree – magnitude and duration – that a household is exposed to flood (Piya et al., 2012, Hahn et al., 2009). There was insignificant difference between households' exposure to other climatic hazards like high temperatures and sea level.

Sensitivity: Households' sensitivity is considered as the extent or degree to which the households are affected by the exposure, in this case, flood. In other words, the aspects of the household which are modified or affected by flooding. In this study, the sensitive of household to climate-related flood– is represented by the known impacts in the current study areas and similar terrains; these were the household food situation food (Beaumier and Ford, 2010), health conditions such as malaria and diarrhoea (Mumuni, 2013) and access to water and sanitation (Muller, 2007).

Adaptive capacity: The adaptive capacity of a household is considered as the ability of the system to withstand or moderate potential damage from climate change or variability (Ebi et al., 2006). Following the theoretical underpinnings of several studies, the adaptive capacity is considered as a function of households' sociodemographic profile, livelihood strategies and social networks (Opiyo et al., 2014, Deressa et al., 2009, Few et al., 2006, Can et al., 2013). Notenbaert et al. (2013) acknowledge that these are the factors that may either pump up a households' adaptive capacity by strengthening their ability to self-protect and recover from climatic hazards or do the reverse (weaken adaptive capacity) by exposing households to greater impact from the climatic hazard.

After determining the indicators for exposure, sensitivity and adaptive capacity, the three contributing factors are combined to yield the household vulnerability index. Besides the household vulnerability that the study hypothesises to influence coping and adaptation strategies,

community factors (**A**) such as institutions, the presence of social groups, non-governmental organisations as well as government interventions in times of flood may modulate the type of coping or adaptation strategy households embark on. In other words, the type of coping and/or adaptation strategies a household embarks on may be influenced by existing institutional or organisation support the community is exposed to before, during and after flooding. This was, however, not within the limits of the current study. Community vulnerability in this study is operationalised as an aggregate of their household vulnerabilities.



Future 2. 1 Conceptual framework showing factors contributing to household vulnerability and the relationship between vulnerability and household coping/adaptation strategies

CHAPTER THREE

RESEARCH DESIGN, STUDY AREA AND METHODS

3.0 Overview of study design and theory

This study was embedded in the Climate Change Adaptation Research and Training Capacity for Development (CCARTCD) project. This research is housed in the Regional Institute for Population Studies (RIPS), University of Ghana, Legon. The overall aim of the CCARTCD-RIPS was to improve knowledge and understanding of the impacts of climate change on the food security and health situation of households in resource-poor coastal urban communities in Accra, Ghana.

The study was a cross-sectional. The primary aim was to develop a household vulnerability index, compare it with households' own perceived vulnerability to floods and examine its influence on their coping strategies. Given that the study sought to quantify household vulnerability and use standardised measures that facilitate comparison and statistical aggregation of data, a quantitative study approach was employed (Bernard and Bernard, 2012). Using semi-structured questionnaires, the principal method employed for data collection was a community survey.

Ethical approval was by the Institution Review Board of the Noguchi Memorial Institute for Medical Research at the University of Ghana, Legon. All the participants provided written informed consent for themselves and their children. Detailed methodological approaches, including sampling strategies used for this study, are discussed in this chapter following a brief description of the study area and its vulnerability to climatic hazard-flooding.

3.1 Study communities

The study was conducted in two communities in Accra, an urban metropolis in coastal Ghana (5.55° N, 0.20° W). Accra is the administrative and commercial capital of Ghana, occupying an

approximate area of 114 km² with a total population of approximately 2 million. This region lies in the coastal savannah agro-ecological zone which has a bimodal rainfall pattern with annual mean precipitation varying between 790 mm on the coast to about 1270 mm in the extreme north. The two study communities were James Town and Agbogbloshie (Figure 3.1). Whereas people in James town are predominantly indigenous Ga, Agbogbloshie is a multi-ethnic migrant community set in a major market area. These neighbourhoods were chosen for two main reasons:

- i. The impact of climate change and variability on the coastline and its impact on the various livelihoods of the populace (Codjoe et al., 2014)
- ii. The study locations are characterised by rapid population growth with poor social amenities leading to severe social, economic and physical repercussions, exacerbating the impact of climate change.

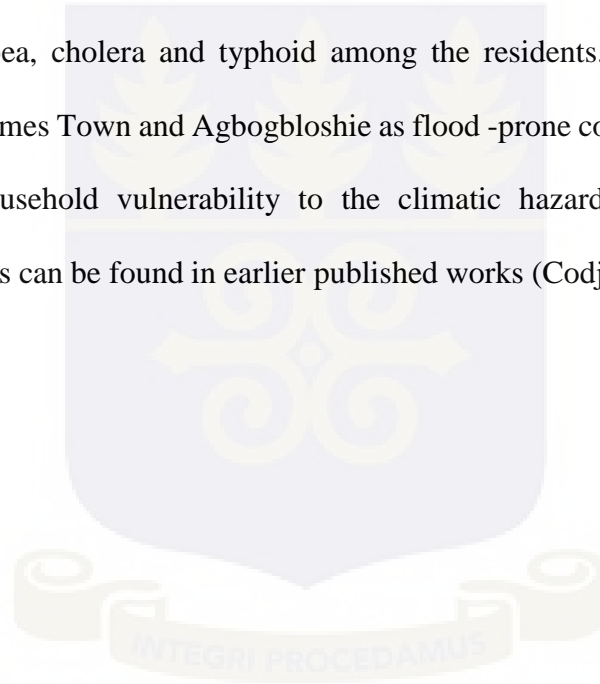
The prevailing conditions in the two communities are uniquely different from rural settings that have hitherto seen more interest when it comes to the impact of climate change and variability. Indigenes of James Town are believed to have migrated from Nigeria via Benin by land and sea in the 14th Century (Henry and Fayorsey, 2002, Buah, 1998). This makes James Town one of the oldest settlements in Accra. The inhabitants are mainly traders, fishermen and individuals engaged in fish-related income generation activities. This enclave is also characterised by a vibrant youthful population and has produced several brilliant footballers and boxers, some of whom have earned both local and international accolades. In the neighbourhood of James Town is Agbogbloshie, which is home to an important food market in the region, and a preferred destination for itinerant traders and rural-urban migrants. Table 3.1 shows the percentage of population increase of the two communities juxtaposed with that of national and Greater Accra Region.

Table 3. 1 Population increase from 2000 –to 2010

	Population 2010	Population Increase from 2000 (%)
Ghana	24,658,823	30.4
Greater Accra region	4,010,054	38.0
James Town	14,279	4.9
Agbogbloshie	8,305	17.7

Source: Ghana Statistical Service, 2012

Coupled with inadequate planning, poor infrastructure, and population pressure, these locations are often burdened by seasonal flooding and record high incidence of climate-sensitive diseases such as malaria, diarrhoea, cholera and typhoid among the residents. The UN Habitat report (2011), considers both James Town and Agbogbloshie as flood -prone communities; this gives the impetus to examine household vulnerability to the climatic hazard flood. Other detailed information on study sites can be found in earlier published works (Codjoe et al., 2014, Cassels et al., 2014).



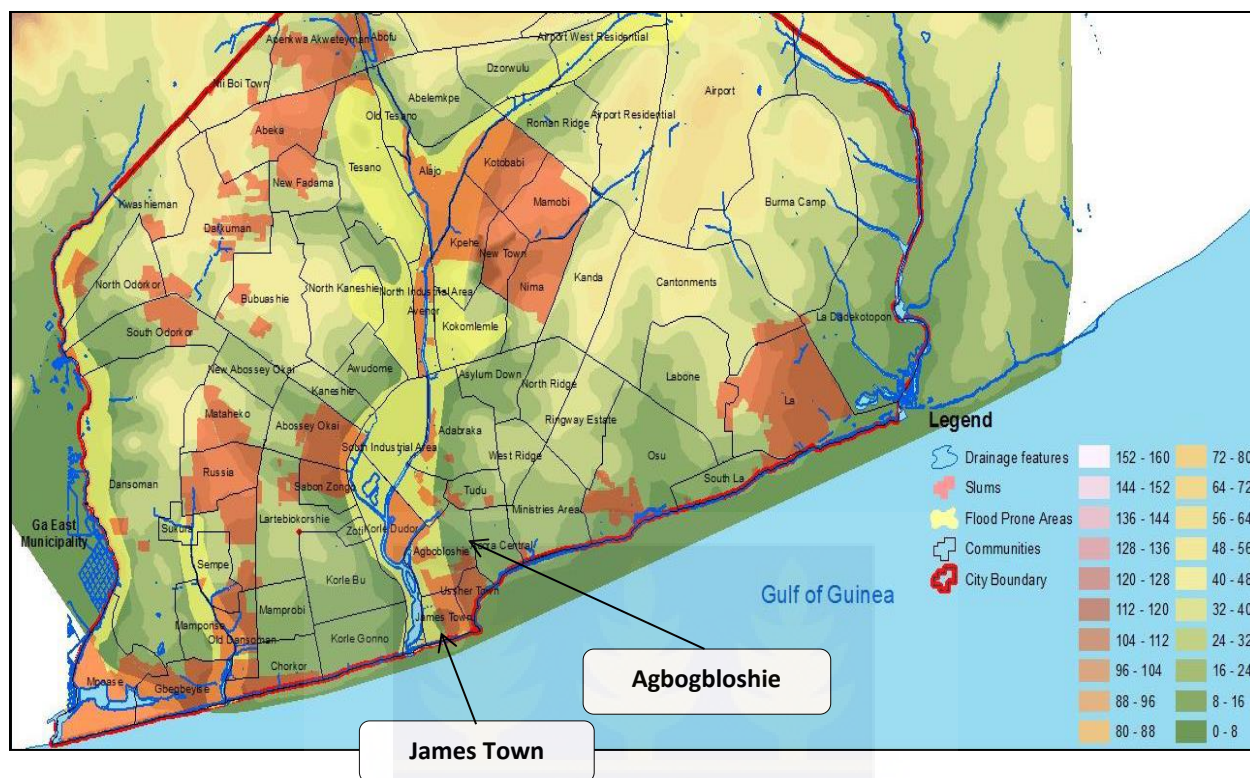


Figure 3. 1 Map of Accra showing study sites

Source: UN Habitat 2011

3.2 Sampling frame

The sampling frame of this study is based on previous surveys done in the study communities in 2011 by EDULINK Survey by RIPS. The EDULINK project is an urban health and poverty project conducted by the Regional Institute for Population Studies (RIPS). This sampling frame was based on demarcated enumeration areas (EAs) used for Ghana's 2000 and 2010 census data collection. This sampling frame has been used by other national surveys such as Multiple Indicator Cluster Survey (MICS) and Ghana Living Standards Surveys (Asenso-Okyere et al., 2000) making this relevant when overlaying available information. The selected enumeration areas were used as the basis of sampling also because through the EDULINK surveys RIPS had established itself in communities providing adequate information concerning the culture and geography of the area.

These EAs are also representative of the study communities(Codjoe et al., 2016, Cassels et al., 2014).

A total of 13 enumeration areas (EAs); 8 in James Town and 5 in Agbogbloshie were used. These EAs sampled were representative of the study communities. The sampling procedure employed involved, first, the listing of households in all enumeration areas and assigning them unique identifiers. Secondly, based on the number of households targeted, the households were then systematically sampled. Overall, 92 households were interviewed in Agbogbloshie and 178 households were interviewed in James Town. Thus, a total of 270 households were interviewed reflecting a response rate of approximately 91 percent. Eligible respondents for the interviews were household heads in selected households who were living in the community and agreed to willingly participate in the research.

3.3 Data collection

Based on the overall and specific objectives of the study, two main sources of data were used.

- 1) Literature review for the selection of household vulnerability indicators
- 2) A community survey to capture household perceive vulnerability and household indicators for the computation of household vulnerability index and other sociodemographic and economic parameter.

3.3.1 Calculation of vulnerability index from selected indicators

Selecting indicators to represent a vulnerability index has been either data-driven and/or theory-driven (Vincent, 2004). An extensive literature review via search engines such as Google scholar, PubMed and JSTOR was conducted to select indicators of household adaptive capacity, sensitivity and exposure, particularly in resource-poor environments in concurrence with primary

Table 3. 2 Component of vulnerability index identified for resource-poor urban communities

Major Component	Contribution to vulnerability	Survey questions	Effect on vulnerability
Socio-demographic profile	Age	Age of Household (H) head	+
	Sex of HH head	Sex of HH head: Female Head	+
	Education	Education level of H Head	-
	Building material	Building materials of walls: brick /cement	-
	Welfare /Being	Household <i>want parameter</i>	+
Livelihood strategies	Employment status	Number of H members not employed	+
		H Head's employment status: HH head employed	-
Social Network	Social capital	H with no social linkage or support from friend and/or relatives	+
		H cannot rely on receiving support	+
Health	Access to health provision	Time taken to the nearest hospital/health	+
	Diarrhoeal incidence	Diarrhoea cases reported over the past month by H members	+
	Malaria prone index	H with no windows covered with mosquito-proof screens/net	+
Water and sanitation	Water safety	H with no indoor pipe or improved water source	+
	Water assess	H without daily supply of water	+
	Sanitation	H without improved toilet facility	+
Food	Food Security	H did not have enough food to eat in a day or more over the past month	+
	Food security	Average number of full meals taken by HH members	-
Climate variability factor	Flooding	Moderate or severe. The impact of the flood in the neighbourhood	+
		H affected by flooding	+

H-Household Source: Compiled by the Author, 2015

data collected from a household community survey conducted. Indicators are explained in the literature review section of this work.

Household vulnerability Index was computed from the summation of the seven (7) major components of vulnerability- sociodemographic profile, livelihood profile, health, food, water, sanitation, flood and social capital. Based on the IPCC definition of vulnerability, an IPCC vulnerability index was also computed. This was done by aggregating the computed seven major components of vulnerability to represent households' exposure, adaptive capacity and sensitivity to floods. The selection of indicators for the various sub-components of the livelihood vulnerability index was discussed in Chapter Two. Table 3.2 shows the indicator of vulnerability and how the variable influences vulnerability to floods.

In Table 3.2, the column 'effect of vulnerability' explains the direction of vulnerability for each indicator:

- A positive (+) sign means an increase in the units of the variable/indicator increases the vulnerability of a household to flood.
- A negative (-) sign means an increase in the units of the variable/indicator decreases household or community vulnerability.

Due to variations in the units for the various indicators of vulnerability, it was necessary for each measure to be standardised. Conversion or standardization of unit was based on the same principle employed for the development of Human Development Index (Anand, 1994, Cooke et al., 2007):

$$index_{sc} = \frac{S_c - S_{min}}{S_{max} - S_{min}} \quad 3.1$$

Where S_c represent the value of the household indicator, S_{min} and S_{max} are the minimum and maximum values of the variable respectively for each indicator using data from study

communities. The value of each indicator is then aggregated to calculate an average value for the main sub-component using the equation based 3.2

$$M_h = \frac{\sum_{i=1}^n index_{s_{ci}}}{n} \quad 3.2$$

Where M_h represents a sub-component; (sociodemographic profile (SDP), livelihood strategies (LS), social capital (SC), Health (H), food (F), water and sanitation(W), or and climate Variability (CV)) for the household. $index_{s_{ci}}$ signifies the indicator, indexed by i making up for each indicator, and n is the number of indicators in each sub-component. Values obtained for all sub-components for a household were then averaged to obtain a household level vulnerability index (HVI). This is shown in equation 3.3.

$$HVI = \frac{\sum_1^7 W_{M_i} M_{di}}{\sum_1^7 W_{m_i}} \quad 3.3$$

An expanded version of equation 3.3 can be represented as:

$$HVI = \frac{W_{SCP}SDP_H + W_{LS}LS_H + W_{SC}SC_H + W_HH_H + W_FF_H + W_WW_H + W_CV CV_H}{W_{SDP} + W_{LS} + W_H + W_{SC} + W_F + W_W + W_{CV}}$$

From equation 3.3, HVI represents the household vulnerability index. This is equal to the weighted average of all seven sub-component of vulnerability.

Employing the IPCC approach to calculate vulnerability

This approach is based on the IPCC definition of vulnerability. Households' vulnerability is the net effect of households' adaptive capacity and biophysical characteristics (Sensitivity/Exposure). Households' exposure in this study is considered as the experience of

flooding as defined in Table 3.2 above. A combination of the sociodemographic profile, livelihood strategies and social capital makes up the household’s adaptive capacity. Sensitivity was measured by ascertaining the status of the household health status, water and sanitation security and food situation. Computation of the IPCC-vulnerability index follows a similar procedure for the HVI calculation above up to Equation 3. For the IPCC-Vulnerability index, after values of each of the seven main components of a community is derived, they are grouped into indicators making up adaptive capacity, exposure and sensitivity as shown in Table 3.3.

Table 3. 3 Major components and sub-component contributing to household vulnerability based on IPCC definition of vulnerability

Major component	Sub components
Adaptive capacity	Socio-demographic profile, livelihood strategies and social capital
Sensitivity	Health, water and sanitation and food insecurity
Exposure	climate variability

The value for the various main component of vulnerability is then calculated as:

$$MC_h = \frac{\sum_{i=1}^n Wm_i M_{di}}{\sum_{i=1}^n Wm_i} \tag{3.4}$$

Where 3.4 MC_h represents the IPCC-defined component/factor contributing to vulnerability.

Equation 4.4 shows how to derive a value for the adaptive capacity /sensitivity/exposure for a household. Wm_i is the weight of each main component and n is the number of sub-component making up the main component. When the values for a household adaptive capacity, exposure and sensitivity have been calculated, equation 5 is used to derive household vulnerability based base on the IPCC definition as follows:

$$IPCC - vulnerability = Sen_h * (Exp_h - Ad_h) \quad 3.5$$

Where the calculated value for the household sensitivity is Sen_h , Exp_h is the household exposure and Ad_h is the adaptive capacity of the household. To generate overall vulnerability for the study communities (CVI), an average of the household vulnerabilities was computed as

$$CVI = \frac{\sum_{i=1}^n HVI_{hi}}{N} \quad 3.6$$

Where HVI represents the vulnerability value for each household and N is the total number of sampled households in the community.

3.3.2 Community survey

A seventeen-paged household questionnaire was administered to the household heads and on very few occasions to a household member with adequate knowledge on household information. One-on-one interviews were conducted. The study questionnaires are presented in Appendix A. Study enumerators were trained for two days and were made to role play the interview process before conducting the data collection. The study questionnaire was developed in English; however, interviews were conducted in Ga, Twi and English, depending on the household head's preferred language of communication. All questions were pre-tested before finally adopted into the survey. For quality assurance purposes, a random sampling of interviews conducted by each enumerator was repeated by field supervisors.

The different sections of the questionnaires solicited for information ranging from general household sociodemographic characteristics (age and sex of household head and other members, education levels, assets) to livelihood strategies and experience of the household to climatic hazards, particularly flooding in their community of residence. Other information collected includes household food, water and health security situation. The coping strategies taken by

households in the event of flooding were also solicited. Information collected later informed the households' adaptive capacity, their exposure (i.e. flood) and the household sensitivity (i.e. food, Water and sanitation and health) to flood.

The main community survey was conducted within a period one month. It did span from the first week in September 2013 to the first week of October 2013. A follow -up to identify the various coping and adaptation measures to floods was collected afterwards.

3.4 Data management and analysis

The data collected was entered using a CsPro data entry interphase and exported into STATA 12 and Excel 2010 for all the quantitative analyses.

3.4.1 Dependent and Independent variables

Predictors of two different dependent variables were investigated in this study. First, after developing the household vulnerability index (HVI), it was compared to the perceived vulnerability of the households to determine households that underestimated their vulnerability or otherwise. Household estimation of vulnerability (i.e. underestimation =1, or otherwise =0) was considered as the dependent variable. Variables explored as plausible independent predictors of estimation of household vulnerability included the sex of household head (female head=1, male head=0), the age of household head, formal education status, employment status, marital status and migrant status (non-migrant=1, migrant=0). The second dependent variable investigated was the coping/adaptation strategies used by households during exposure to a climatic hazard, in this case, flooding. Major contributing components of the households' vulnerability index were considered as the main independent variables of interest. Other correlates of household coping strategies were also explored.

3.4.2 Data analyses

Data analyses were conducted using Microsoft Excel and statistical software package STATA. Frequencies, percentages and means of household demographic and economic characteristics and vulnerability indicators were represented in a tabular and graphical form in Chapter Five.

Specific analyses done to achieve each objective were:

- **Objective II;** To Compare the vulnerability of households in James Town to households in Agbogbloshie

Chi-square analysis of the 18 indicators of vulnerability was performed to examine the statistical difference between categorical variables of the two study communities- James Town and Agbogbloshie. Mean comparison of the computed major components of vulnerability as well as their aggregated adaptive capacity, sensitivity and exposure are also computed as continuous variables. Graphical representations of results were employed using Microsoft Excel.

- **Objective III:** Examine the relationship between the computed livelihood vulnerability index and the perceived vulnerability of households.

Perceived vulnerability of households was determined by asking household heads how they perceived their own household vulnerability to excessive rainfall and flood in their communities.

Household heads responded by indicating one of the following four options

- 1: Household not vulnerable / with low vulnerability,
- 2: Household somewhat vulnerable/medium vulnerability
- 3: Household is vulnerable / high vulnerability
- 4: Household is very vulnerable

Household vulnerability Index was computed following the methodology described in Chapter Five. A Kendall's Tau-b correlation analysis is performed to ascertain the correlation between the

perceived vulnerability and computed vulnerability index. A Kendall's Tau correlation analysis is a non-parametric correlation analysis aimed to assess and test correlations between non-intervals scaled ordinal variables (Bolboaca and Jäntschi, 2006). Although comparable to Spearman rank correlation coefficient which is like Pearson correlation, Kendall tau correlation rather represents a probability. Kendall's Tau test is also considered to be more robust to extreme observations and nonlinearity thus preferred in this study (Newson, 2002). This is used to estimate the correlation between perceived and computed vulnerabilities.

The Kendall coefficient is denoted with the Greek Letter tau (τ) $T = (4P / (n(n-1))) - 1$: where P is the number of concordant pairs and calculated as the sum over all the items, of items ranked after the given item by both rankings.

Kendall's Tau test represents a probability. It is used to test the null hypothesis that the probability of perceived household vulnerability is in the same order as computed household vulnerability versus the alternate that the probability that the two measures are not in the same order.

- **Objective IV:** Examine the socio-demographic characteristics associated with households underestimating of their vulnerability and **Objective V-**To examine the relationship between household's vulnerability and their coping and/or adaptation strategies.

The dependent variable is binary; taking the value 1 if a household head underestimates household vulnerability (comparing their perceived vulnerability with computed household livelihood vulnerability) and 0 otherwise. The explanatory variables include sex of household head, age of household head, household' head level of education, migration status (migrant =1, 0=Otherwise) and marital status (married=1, 0=otherwise). Following the literature, it is expected that households that have been impacted directly by floods will be less likely to underestimate their vulnerability compared to their counterparts that have not been impacted directly by floods

(Siegrist and Gutscher, 2008). Female household heads were also expected to be less likely to underestimate their household vulnerability compared to male household heads (Terpstra and Lindell, 2013) because they tend to have a high risk perception of hazards. Older household heads were also expected not to underestimate the household vulnerability to floods (Kellens et al., 2011).

Other independent variables explored for a possible relationship with underestimation of vulnerability were household wealth, migration status of the household head, household head's employment status and religion.

The empirical model to estimate the logistic regression can be represented as:

$$\ln\left(\frac{\rho}{1-\rho}\right) = \alpha + \beta_1 MS + \beta_2 EMP + \beta_3 AGE + \beta_4 AGE^2 + \beta_5 EDU + \beta_6 REL + \beta_7 Sex + \ell \dots\dots\dots 3.7$$

Where $\rho \rightarrow$ the probability of a household head underestimating household vulnerability

- α : Constant
- β : Regression coefficients
- MS : Household head's marital status
- EMP : Employment status of household head
- AGE : Age of household head
- EDU : Household head's level of formal education
- REL : Religion of household head
- SEX : Sex of household head
- ℓ : Unexplained error term

The empirical equation estimated for the coping function (relocating =1, 0=otherwise) is specified as:

$$\ln\left(\frac{\rho}{1-\rho}\right) = \alpha + \beta_1SDP + \beta_2LS + \beta_3SOC + \beta_4HV + \beta_5WS + \beta_6FD + \beta_7CV + \beta_8MIG + \ell \dots\dots\dots 3.8$$

Where $\rho \rightarrow$ the probability of a household relocating as a coping strategy

$\alpha \rightarrow$ Constant

$\beta \rightarrow$ Regression coefficients

$SDP \rightarrow$ Sociodemographic vulnerability

$LS \rightarrow$ Livelihood strategies vulnerability

$SOC \rightarrow$ Social capital vulnerability

$HV \rightarrow$ Health vulnerability

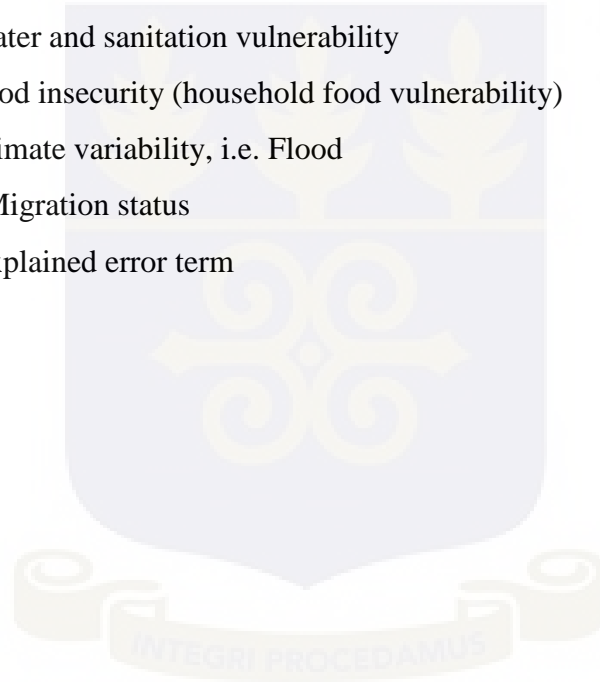
$WS \rightarrow$ Water and sanitation vulnerability

$FD \rightarrow$ Food insecurity (household food vulnerability)

$CV \rightarrow$ Climate variability, i.e. Flood

$MIG \rightarrow$ Migration status

$\ell \rightarrow$ Unexplained error term



CHAPTER FOUR

HOUSEHOLD VULNERABILITY INDEX IN THE TWO STUDY COMMUNITIES

4.0 Introduction

A notable reason for the emergence of various methodologies for the assessments of household and community vulnerability to climate-related hazards such as floods is the quest to quantify how communities differ in vulnerability and adapt to changing environmental conditions over time and respond to interventions.

4.1 Community sociodemographic characteristics and vulnerability indicators

Community sociodemographic characteristics and indicators contributing to households' vulnerability are presented in Table 4.1. For the total number of 270 households interviewed, 178 (64.9%) were from James Town and 92 (34.1%) from Agbogbloshie. The average age of household heads was 44.6 years ($SD= 16.3$). Less than a fifth of the sampled households had household heads that were above sixty years of age. significantly more household heads in James Town were older than sixty years compared to their counterparts in Agbogbloshie ($p<0.001$). This was not surprising as James Town is a more traditional community with generational families compared to the relatively migrant population seen in Agbogbloshie.

Approximately 45% of the households in the total study sample were headed by females. Less than a fifth (15.9%) of household heads had no primary education in both communities. Agbogbloshie had significantly more houses built with materials other than brick/cement than those in James Town ($p<0.001$). The significantly higher *want parameter* of households in James Town indicates that households in James Town are less satisfied with their monetary incomes compared to their counterparts in Agbogbloshie.

Table 4. 1 Household (H) sociodemographic, economic and environmental indicators of Agbogbloshie (AG) and James Town (JT)

Major Component	Subcomponent	Total N=270	AG n=92	JT n=178	Sign. level
Socio-demographic profile	H head above 60 years	18.1	6.5	24.2	***
	Female-headed H	44.8	46.7	43.8	
	H Head with no primary education	15.9	18.5	14.6	
	H with building material not brick/cement	28.5	57.6	13.5	***
	Household <i>want parameter</i> ¹	8.4	8.2	8.6	**
Livelihood strategies	H members not employed	42.4	34.4	47.0	**
	H heads with no occupation	18.9	5.43	25.8	***
Social capital	Average receive: give ratio ²	1.14	0.90	1.27	**
	H cannot rely on receiving support	43.0	55.4	36.5	**
Health	Time taken to the nearest hospital/health ³	25.2	22.7	26.5	**
	H with diarrhoea cases over the past month	21.8	25.0	20.2	
	H with no windows covered with mosquito-proof screens/net	34.1	40.2	30.9	
Water and sanitation	H with no indoor pipe or improved water source	20.4	23.9	18.5	
	H without daily supply of water	13.3	2.2	19.1	***
	H without improved toilet	78.9	91.3	72.5	***
Food insecurity	H did not have enough food to eat in a day or more over the past month	16.3	22.8	12.9	**
	Average number of full meals taken by H members ⁴	2.6	2.3	2.7	***
Climatic stress / flood	Experience flood in neighbourhood	20.0	35.9	11.8	***
	H affected by flooding	15.2	25.0	10.1	***

All values represent percentages except otherwise indicated. * implies significant at 10%; ** implies significant at 5%; *** implies significant at 1%. ¹Household want parameter: a subjective measure of welfare indicative of how satisfied individual's income level meets his/her satisfaction. ³Time taken in minutes to reach the nearest hospital/health centre. ⁴ The average (count) of full meals taken in a day

Being a major food hub/market in the metropolitan, it was not surprising that Agbogbloshie had significantly fewer household heads ($p<0.001$) and proportion of household members ($p<0.001$) that were not working compared to the populace in James Town. The presence of a food market

serves as a major entry for both food-related and food-unrelated businesses. On the average, it takes significantly less time for households in Agbogbloshie to get to the nearest hospital than for households in James Town ($p=0.001$). The study revealed that only a little above a fifth (21.1%) of the households had access to improved toilet facilities. Unsurprisingly, Agbogbloshie, with its numerous slum locations had significantly more unimproved toilet facilities ($p<0.001$). Significantly, more households in Agbogbloshie reported not having enough food to eat for at least a day over the last one month prior to data collection ($p< 0.037$) and had households consumed significantly fewer meals (average number/frequency of meals per day) than households in James Town ($p<0.001$). Significantly, more households in Agbogbloshie are affected by floods compared to households at James Town ($p=0.001$).

Approximately a fifth of the study population (20.4%) did not use improved water source; 34.1% of the households did not use any mosquito-proof screens, and 21.8% of households reported to have had a case of diarrhoea over the past month prior to the data collection. No statistical differences existed between the studied communities on these parameters –percentage of unimproved water sources, households with mosquito-proof screens and the number of observed cases of diarrhoea over the past month prior to data collection.

4.2 Household major and minor components of vulnerability

Table 4.2 shows the computed vulnerability score for each indicator and the aggregated major components and overall household vulnerability.

Table 4. 2 Major components and Indicators of vulnerability of Agbogbloshie and James Town

Major component	Indicators	AGB	JT	
Sociodemographic profile		0.356	0.298	**
	H head above 60 years	0.065	0.242	
	Female-headed H	0.467	0.438	
	H Head with no primary education	0.185	0.146	
	H with building material, not Brick/cement	0.576	0.135	
	Household want parameter	0.488	0.530	
Livelihood strategies		0.199	0.364	***
	H members not employed	0.341	0.467	
	H heads with no occupation	0.054	0.258	
Social capital		0.353	0.297	*
	Average receive: give ratio	0.151	0.228	
	H cannot rely on receiving support	0.554	0.365	
Health		0.320	0.238	**
	Inverse of time taken to the nearest hospital/health	0.307	0.204	
	H with diarrhoea cases over the past month	0.250	0.202	
	H with no windows covered with mosquito-proof screens/net	0.402	0.309	
Water and sanitation		0.391	0.367	
	H with no indoor pipe or improved water source	0.239	0.185	
	H without daily supply of water	0.022	0.191	
	H without improved toilet	0.913	0.725	
Food		0.355	0.108	***
	H did not have enough food to eat in a day or more over the past month	0.228	0.129	
	Inverse Average number of full meals taken by H members	0.482	0.087	
Climatic stressor (flood)		0.305	0.110	***
	Experience flood in neighbourhood	0.359	0.118	
	H affected by flooding	0.25	0.101	
Overall Vulnerability Index		0.333	0.266	***

Significant difference *** P<0.001, ** P< 0.05, * P<0.1.

Sociodemographic Profile

Although household heads in James Town were more vulnerable with respect to their age (significantly more of above sixty years olds) than those in Agbogbloshie, household heads in Agbogbloshie had a significantly greater proportion of uneducated household heads and had more building made of a material other than brick/cement. Overall, Agbogbloshie showed greater vulnerability on the sociodemographic profile index than James Town (0.356_{Agbogbloshie} SD 0.19 vs. 0.298_{James Town} SD 0.19: P= 0.02).

Livelihood profile

Given that Agbogbloshie is more economically active than James Town, unsurprisingly James Town was shown to be more vulnerable than Agbogbloshie in this regard (0.197_{Agbogbloshie} SD 0.24 vs. 0.362_{James Town} SD 0.36: P= 0.02).

Social capital

Being a more indigenous community, James Town proved rightly to have better social capital compared to the more migrant population in Agbogbloshie. Agbogbloshie was shown to be more vulnerable with respect to social capital (0.353_{Agbogbloshie} SD 0.24 vs. 0.296_{James Town} SD 0.24: P= 0.07).

Health

The average distance of households in James Town from a health centre/post was significantly further than that of the houses in Agbogbloshie; the proportion of household with diarrhoea cases over the past month and with no mosquito-proof screens was greater in Agbogbloshie than James

Town. Overall Agboglobloshie showed a greater vulnerability on the health profile ($0.319_{\text{Agboglobloshie}}$ SD 0.24 vs. $0.239_{\text{James Town}}$ SD 0.22: $P= 0.006$).

Water and sanitation

No statistical difference existed between the two study communities with respect to Water and Sanitation.

Food insecurity

Households in Agboglobloshie were more vulnerable than their counterpart in James Town ($0.356_{\text{Agboglobloshie}}$ SD 0.26 vs. $0.103_{\text{James Town}}$ SD 0.17: $P<0.001$). This may reflect the poorer sociodemographic profile of Agboglobloshie compared to James Town.

Climatic stress (flood)

Agboglobloshie is a lowland community with a poor drainage system. More households in Agboglobloshie experienced flooding in their neighbourhood and were affected by the floods themselves compared to their counterparts in James Town. Agboglobloshie showed to be more vulnerable with respect to floods ($0.250_{\text{Agboglobloshie}}$ SD 0.26 vs. $0.103_{\text{James Town}}$ SD 0.17: $p<0.001$)

Overall vulnerability

The mean overall vulnerability score of Agboglobloshie (mean= 0.333, SD=0.10) was significantly greater than the mean overall vulnerability score of James Town (0.265, SD=0.10), $p=0.00$. The results of the major component calculations are presented collectively in a spider diagram (Figure 3). The scale of the diagram ranges from 0 (not at all vulnerable) at the center of the web, increasing to 0.5 (most vulnerable) at the outside edge in 0.1unit increments.

Figure 4.1 shows that Agboglobloshie is more vulnerable with respect to five of the major components (sociodemographic, social capital, health, food and climate variability) contributing

to overall vulnerability. James Town exhibited greater vulnerability with respect to livelihood strategies and water resources.

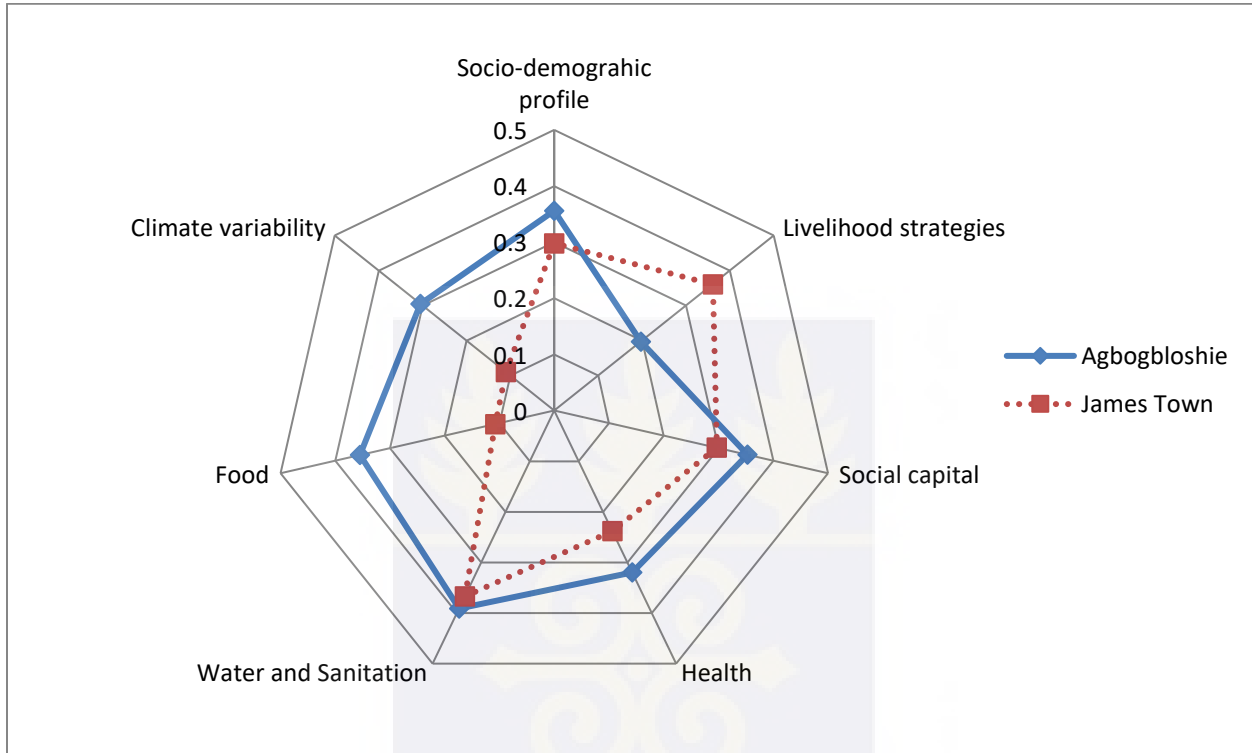


Figure 4. 1: Vulnerability spider diagram of the main components of the household vulnerability index by study communities

4.3 Vulnerability of communities by the IPCC definition

The vulnerability of the communities based on the IPCC definition of vulnerability (Equation 5) is shown in Table 4.5. The Agboglobshie community was still more vulnerable to floods compared to James Town when the HVI-IPCC analysis was employed. Table 4.5 shows the contributing factor scores for exposure, adaptive capacity, and sensitivity. Agboglobshie is significantly more exposed (0.304) to flooding than James Town (0.109) and more sensitive (0.406 vs. 0.289 respectively).

The overall IPCC-vulnerability scores indicate that households in Agbogbloshie households are more vulnerable than households in James Town (-0.005 vs. -0.056 respectively).

Table 4. 3 IPCC defined contributing factors towards vulnerability by communities

Contributing factor	Communities		
	Agbogbloshie	James Town	
Adaptive capacity	0.320	0.312	
Exposure	0.304	0.109	***
Sensitivity	0.406	0.289	***
Vulnerability Index			
IPCC-LVI	-0.005	-0.056	

Significant difference *** P<0.001, ** P< 0.1, * P<0.05

Index values should be interpreted as relative values to be compared within the study sample only. The IPCC- vulnerability is on a scale from -1 (least vulnerable) to 1 (most vulnerable).

4.4 Vulnerability index and its components by vulnerability quartiles

For inter-household analysis, households' vulnerability scores were grouped in percentiles to represent those belonging to low, medium, High and Very high vulnerability categories. The first quartile represents the least vulnerable and the fourth quartile represents the most vulnerable households (Table 4.4). Those households with low adaptive capacity/ more vulnerable adaptive capacity profile were also more exposed and sensitive to floods

Table 4. 4 Mean values of component of vulnerability by the level of overall vulnerability

Component of vulnerability	Percentile category of household vulnerability index							
	Low		Medium		High		Very High	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Adaptive capacity	0.19 ^a	0.1	0.29 ^b	0.1	0.39 ^c	0.1	0.45 ^d	0.1
Sensitivity	0.21 ^a	0.1	0.28 ^b	0.1	0.34 ^b	0.1	0.48 ^c	0.1
Exposure	0.01 ^a	0.1	0.10 ^a	0.3	0.15 ^b	0.3	0.45 ^c	0.5

^{a, b, c, d} Mean values within a row with unlike superscript letters were significantly different (the Bonferroni test was used for multiple comparisons; P<0.05).

4.5 Discussion

That flooding is a major natural disaster in the study communities is not contested. However, the impact of these floods varies from one household to another due to the different levels of exposure -flood-, adaptive capacity- sociodemographic, livelihoods, social networks- and sensitivity - health, food security, and water and sanitation.

Comparing the vulnerability of household in Agbogbloshie and James Town

Figure 4.1 shows which household characteristics contribute to their vulnerability to floods. Overall Agbogbloshie was found to be more vulnerable to floods compared with James Town. The vulnerability indicators do show that even though more households in Agbogbloshie are exposed to the impact of floods than their counterpart in James Town, reportedly, there are also significantly more non-brick/cement houses in Agbogbloshie. This might be an indication of the general poorer sociodemographic profile of Agbogbloshie and can also be explained by other complex issues like the illegal nature of building in some locations in Agbogbloshie. In the urban cities, illegal occupation is considered as an unauthorised land development or illegal subdivision on the fringes of the cities resulting in a low standard of services or infrastructures (Adeniji and Ogundiji, 2009). Due to the illegal nature of households building in some parts of Agbogbloshie and the low socioeconomic status of households in this community, the households located in such areas tend to live more in temporary structures- wooden structures like kiosk – constantly exacerbating their vulnerability to flooding.

Expectedly, James Town was more vulnerable with respect to their livelihood strategies. Since Agbogbloshie serves as a major food market, many more household members in this community were engaged in trading in both food items and non-food items compared with their counterparts at James Town. The economic condition in Agbogbloshie makes it a constant destination for

itinerant trading migrants who have over the years remained in the community for trading purposes. The massive economic activity community is often among the many reasons why suggestions of relocating are highly debated (Jha and Dwyne, 2010).

The average time for households in James Town to get to a hospital or health post is greater than the average time taken by households in Agbogbloshie. The percentage of households in Agbogbloshie that are mosquito and diarrhoea prone far exceeds those in James Towns granting Agbogbloshie her significantly higher health vulnerability. Although floods could pose risk to other health conditions, the use of how households are prone to malaria and diarrhoea as contributing factors to health vulnerability has been validated in previous studies. The incidence of these disease conditions are common in the study localities and also proven to be associated with floods (Mumuni, 2013, Torti, 2012, WHO, 2014a). Besides ensuring reduction and /or elimination of mosquito breeding sites in the community, the benefits of mosquito proof screens/net in the prevention of malaria has been established as an important prevention strategy (Habluetzel et al., 1997, Adongo et al., 2005, Larsen et al., 2014).

Intervention such as increasing the public education on hand washing can reduce the incidence of diarrhoea in both communities. A review of the literature on the impact of hand wash reveals a remarkable reduction of diarrhoea by 42- to 48% when hands are washed with soap and running water. James Town and Agbogbloshie were not significantly different with respect to their water and sanitation vulnerability. However, having approximately 80% of the households of the total sample not having 'improved toilet'² facility is least desired. Although compared to the 'big three' - HIV/AIDS, Tuberculosis, and malaria- much attention has not been given to diarrhoea. However,

² An improved toilet facility is considered as one of the following: Flush toilet, Piped sewer system, Septic tank, Flush/pour flush to pit latrine, Ventilated improved pit latrine (VIP) and Pit latrine with slab.

this disease condition contributes more to the global mortality rate among children than the combined burden of the Big Three (Bartram and Cairncross, 2010). A key measure needed to control diarrhoea is improving household hygiene, sanitation and water conditions. Hence even in the absence of floods which increases the incidence of malaria and diarrhoea, interventions to improve toilet facility such as the provision of KVIP for the community will lessen their sensitivity to diarrhoea and other disease conditions of public health interest.

Interestingly despite being a major food hub in the metropolitan, households in Agboghloshie reportedly were more vulnerable with respect to the food indicators employed by this study- frequency of meals within a day and having recorded a day within the past month prior to the data collection households less had enough food. A possible limitation in these measures might be not accounting for the composition of household members in the food measures. For example, meal frequency and adequacy may be incumbent on the number of adults and children in the households. This result corroborates with those of other studies that show that the least food secure households are also the least adaptive (Wright et al., 2012). For further research, particularly a longitudinal one can explore the impact of flooding on food intake across several time points.

There is an agglomeration of biophysical factors making Agboghloshie more vulnerable with respect to flooding. It is a low-lying land, with poor drainage system and with poorly situated houses on water ways. Amidst continued debate on the legality of the community, improved drainage system must be encouraged to ensure reduction of the negative impact of the floods.

Agboghloshie and James Town: IPCC vulnerability assessment

The IPCC approach to vulnerability shows that Agboghloshie is significantly more vulnerable with respect to exposure and sensitivity to flood (Table 4.3). The exposure and

sensitivity to flood in such localities are driven by several factors by weak local governance and municipal management coupled with the high poverty of the populace (Rahman and Rahman, 2015). Besides the disfavoured topography of Agbogbloshie, lack of adequate infrastructure, and the high population influx, there is also the lack of political will or uncertainty as to how to effectively deal with the issue. This can be mainly attributed to the fact that majority of the houses and structures there are illegal. Illegal occupation of the land is considered as an unauthorized land development or illegal subdivision on the fringes of the cities resulting in a low standard of services or infrastructures (Adeniji and Ogundiji, 2009). Consequently, a usually discussed option is the complete eviction of occupants of such settlements to solve attendant problems. However, Jenkins (2002) and others argue that the 'informal' may have gained adequate roots in a place and are often there to stay, thus may be as legitimate as the 'formal' in urban development. Hence the consideration of adaptation measures aimed to improve the health and livelihood of the populace of 'informal' settings should be embraced.

Although many resource-poor households take some measures to cope with floods, there is the need to construct or upgrade existing drainage and waste collection systems. Community members are usually not able to address such measures alone. Thus, adaptation measures such as relocating the populace should also be discussed together with the construction of improved drainage system and provision of health interventions such as improved access to health facilities and education on sanitation. Households' mosquito prone index contributes significantly to the overall health vulnerability. Given the burden of malaria on overall disease burden, the promotion of the use of mosquito nets should also be encouraged. The use of mosquito net has proven to significantly reduce malaria incidence among such populations, especially children under-five years old (Nyarko and Cobblah, 2014).

Increasing self-help schemes to reduce the households' sensitivity to floods are being encouraged. These may include flood-proofing their buildings and improving on household sanitation that modulates the intensity of disease burden experienced by the households during floods.

Advantages associated with this assessment approach

The utility of this methodology includes being able to:

- i. Compare the vulnerability of two or more communities or households

An indicator approach like the methodology employed in this study enables the accurate comparison of the vulnerability of different location on equal merits. This ensures identifying specific area or point of urgency when planning intervention strategies. Also, this approach is critical to ensure a somewhat equality when addressing the vulnerability of resource-poor communities. By estimating the contributing vulnerability indicators, the limited resource in such localities could be directed to problems in-order priority or preference.

- ii. Compare the vulnerability of communities or households before and after intervention

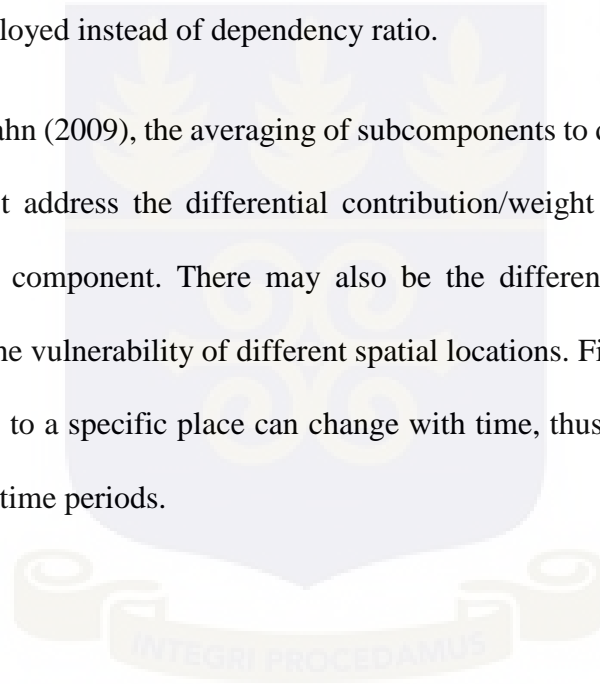
Although the impact or vulnerability to climatic stressors such as floods is multidimensional, the selection of indicators allows the monitoring and evaluating programme interventions much more effectively. With adaptation measures aimed at alleviating and/or minimization of impacts (Ford et al., 2013), the indicator approach helps monitor, particularly with respect to the sensitivity to the climatic stressors even in cases where exposures persist.

- iii. Provides a novel way of ascertaining the relationship between household or community vulnerability and their coping and/or adaptation options (as shown the Chapter 7 of this thesis).

Limitation of the assessment approach

Although sub-component indicators were selected via a systematic review of the literature, they still under-represent the complexities associated with the concept of vulnerability. Hence a set of indicators might not necessarily capture all aspects of vulnerability. This complexity reflects in the wide variation seen in selected indicators even when dealing with vulnerability in similar or same localities. The use of each indicator could be contested with a similar or perceived better indicator intended to measure the same or similar concept. For example, the use of the percentage of household members employed instead of dependency ratio.

Secondly as stated by Hahn (2009), the averaging of subcomponents to derive a major component of vulnerability does not address the differential contribution/weight of each indicator to the magnitude of the major component. There may also be the differential impact of each sub-component indicator to the vulnerability of different spatial locations. Finally, the relevance of an indicator to vulnerability to a specific place can change with time, thus complicating comparing vulnerability at different time periods.



CHAPTER FIVE

PERCEIVED VULNERABILITY VERSUS COMPUTED VULNERABILITY

5.0 Introduction

Globally, understanding households' perception of their vulnerability to the changing climate is a critical component in designing future interventions to address climate change and variability impacts. Public perception of flood vulnerability and risk receives little attention in flood risk management, creating a disconnect between authorities and the public (Bradford et al., 2012). There are some situational factors that evoke individual reactions to experienced floods. This, in turn, directs the inclinations of affected victims to select specific coping or adaptation strategies. The public or localities' perception of risk or vulnerability to climatic hazards often includes elements that are omitted in the scientific assessment of vulnerability (Baan and Klijn, 2004). Understanding individuals' perception of their vulnerability to climatic hazards and comparing this to computed vulnerabilities enables one to investigate the characteristics of households that influence them to either underestimate or overestimate their vulnerability. This information will help in designing appropriate flood information for interventions customised to reach specific groups of people who are more likely to underestimate their vulnerability.

Underestimating or misestimating vulnerability to climatic hazards can hinder the adaptation process, as it can be a reason for either choosing or not choosing adaptation or coping strategies (Sem, 2007). Thus, before determining the relationship between computed household vulnerability and their coping strategies in Chapter Six, Chapter Five presents the relationship between the perceived household vulnerability and computed vulnerability index. This chapter also examines some demographic factors which may amplify or attenuate household perceptions of their vulnerability to climatic hazards.

A household's perception of their vulnerability to the vagaries of the climate could be a result of inter and intra-household characteristics. Although significant scholarship has examined the degree to which various communities detect changes in the climate and accompanying consequences, the comparison between perceived vulnerability and computed vulnerability to climate change and variability is noticeably limited. After determining the relationship between the perceived vulnerability of households and their computed vulnerability indexes, this study investigates possible determinants of households underestimating their vulnerability.

5.1 Relationship between perceived and computed vulnerability

Figure 4 categorises households by the perception of their vulnerability to climate variability, flood. About 49.8% of the households considered their vulnerability as low, whilst approximately, 11.0% considered themselves to be highly vulnerable to climate variability. Table 5.1 indicates a weak correlation between the perceived vulnerability and computed household (equation 4.4) vulnerability at 90% confidence interval ($\tau_b = 0.09, p = 0.07$).

When compared with the seven major contributing components of the computed vulnerability, the index for climatic variability or Exposure ($\tau_b = 0.153, p = 0.015$) was the only component that significantly correlated with perceived vulnerability. The correlation was, however, weak.

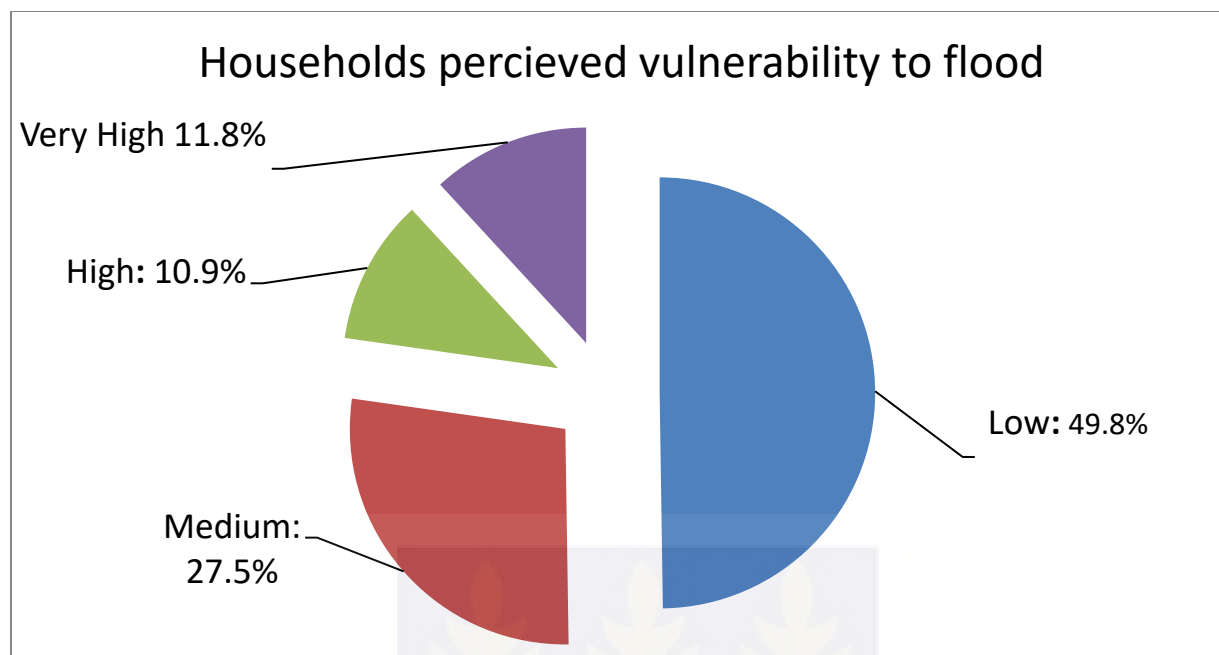


Figure 5. 1: Perceived household vulnerability to flooding

Table 5. 1 Correlation between perceived vulnerability and computed vulnerability

	Kendall's Tau-b	P-value
Livelihood vulnerability index	0.101**	0.055
IPCC vulnerability index	0.046	0.383

Note that the asterisks indicate significant levels: * implies significant at 10%; ** implies significant at 5%; *** implies significant at 1%.

5.2 Households underestimating their vulnerability to floods

Generally, from a flood risk perspective, individuals who are vulnerable and consider themselves not, are of major concern (Bradford et al., 2012). This is because underestimation of vulnerability or risk may hinder both autonomous and planned adaptation and/ or coping options which may offset the impact of hazards. Household heads were asked in the survey to rate their vulnerability to floods as low, medium, high or very high.

To address the question of the extent to which households underestimate their vulnerability, the computed household vulnerability index was also categorized into four categories: low, medium,

high and very high vulnerable households (see Table 5.2). This was done by categorizing vulnerability values into percentiles.

Table 5.2 Categorization of vulnerability levels

Index value		Household	Assigned value
scale		Vulnerability	
0.041	≤ HVI ≥ 0.210	Low	1
0.211	≤ HVI ≥ 0.291	Medium	2
0.292	≤ HVI ≥ 0.367	High	3
0.368	≤ HVI ≥ 0.623	Very High	4

Using the computed household vulnerability index as a reference for the direction of deviation of the household's perceived vulnerability from the computed vulnerability determines whether a household overestimates or underestimates of their vulnerability to floods.

Table 5.3 shows the calculation for household overestimation or underestimation of their vulnerability. Although this study does not consider the computed vulnerability as the 'gold' standard for household vulnerability, the indicators and methodology used to compute household vulnerability index are widely embraced by development organisations, policy-makers, and practitioners in the assessment of vulnerability towards adverse climatic events. From Table 5.3, households that underestimated their vulnerability were the households with a score of 1, 2 or 3. A little over a half (51.18%) of the 211 households eligible for this analysis underestimated their vulnerability to floods.

Table 5.3 Categorisation of households underestimating their vulnerability levels

HVI	HVI-P					Difference in vulnerability estimates (Diff-Vul)			
	<i>X</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>X-a</i>	<i>X-b</i>	<i>X-c</i>	<i>X-d</i>
Low	1	1	2	3	4	0	-1	-2	-3
Medium	2	1	2	3	4	1	0	-1	-2
High	3	1	2	3	4	2	1	0	-1
Very High	4	1	2	3	4	3	2	1	0

HVI: computed vulnerability score; HVI-P: Household perceived vulnerability score

X- Computed household vulnerability score (categorized as 1-low, 2-Medium, 3-High, 4-Very high)

a-households that perceive their vulnerability as low

b-households that perceive their vulnerability as medium

c-households that perceive their vulnerability as high

d-households that perceive their vulnerability as very high

Difference in vulnerability estimates= (Computed estimate – perceived estimate e.g. *X-a*)

Diff-Vul (-1, -2, -3) implies overestimation of perceived vulnerability

Diff-Vul (1,2, 3) implies underestimation of vulnerability

Diff-Vul (0) implies correctly estimates vulnerability

5.3 Correlates of underestimation of households' vulnerability to floods

Table 5.4 contains the descriptive statistics of the variables explored for a possible relationship with household heads' underestimation of vulnerability in the empirical analysis.

- *Household head*: Less than half (45%) of the households were headed by females.
- *Household heads' age*: The mean age of the household was 44.6 years (approximately 44 years and 7 months), and approximately 18.0% of household heads were above 60 years old.
- *Formal education*: Majority of the household heads had at least a primary school education (60%) while less than one-tenth had secondary school education and above.

- *Migration status:* More than two-thirds of household heads were non-migrants. and only 18% of the household heads were not engaged in any form of income generating activities.
- *Marital status:* About 53% of the household heads were either married or cohabiting with a partner.
- *Household heads age:* The mean age of the household heads was 44.6 years.
- *Religion:* Majority (76%) of the household heads belongs to the Christian faith, 14% were Moslems and the remaining 10% were made up of Traditionalist and individuals with no religion.
- *Economic status:* Seventy-nine percent of the household heads were employed with the remaining 21% not employed.

Table 5.4 Descriptive statistics of variables used for the regressions

Household (HH) characteristics		Mean	Std. Dev
Household head			
Female head	(=1, 0 otherwise)	0.45	0.50
Formal education			
No education	(=1, 0 otherwise)	0.16	0.37
Primary education	(=1, 0 otherwise)	0.17	0.38
Secondary and above	(=1, 0 otherwise)	0.67	0.47
Migration status of head			
Migrant	(=1, 0 otherwise)	0.66	0.47
Non-Migrant	(=1, 0 otherwise)	0.34	0.47
Employment status			
Not Employed	(=1, 0 otherwise)	0.21	0.41
Employed	(=1, 0 otherwise)	0.79	0.41
Religion			
Traditional/Spiritual/No religion	(=1, 0 otherwise)	0.10	0.29
Christianity	(=1, 0 otherwise)	0.76	0.43
Islam	(=1, 0 otherwise)	0.14	
Marital status			
Married /living together	(=1, 0 otherwise)	0.53	0.50
Not married	(=1, 0 otherwise)	0.47	0.50
Age of household head (yrs.)		44.64	16.35

5.3.1 Sociodemographic characteristics of households underestimating their vulnerability

Table 5.5 shows the proportion of household heads underestimating their vulnerability to floods by selected sociodemographic characteristics. A significant proportion of female headed household underestimated their vulnerability compared to their male counterparts ($p < 0.001$). The results of this study give credence to the need for further studies to explore gendered perspectives of vulnerability among resource-poor urban communities and that female heads may not always be as vulnerable as perceived. In addition, a greater proportion of household heads that were not employed underestimated their vulnerability ($P < 0.001$). The mean age of household heads was greater for those underestimating their vulnerability compared to household heads who do not underestimate ($p = 0.001$).

There was also a significant difference between the proportions of household heads underestimating their vulnerability within the different educational level categories. Specifically, there was no statistically significant difference between the proportion of household heads with no formal education and those with primary education underestimating their vulnerability (64.7 % vs. 63.9%; $p = 0.943$ respectively). However, significant differences existed between those with no formal education and household heads with secondary and more education (64.7% vs. 44.7%; $P = 0.036$). This difference continued to be significant between household heads with primary education and those with secondary and more education (63.9% vs. 44.7%; $P = 0.040$). The proportion of household heads underestimating their vulnerability to floods did not vary by migration status, marital status or religious affiliation.

Table 5. 5 Sociodemographic characteristics and estimation of vulnerability to floods

Household characteristics	n	Estimation of vulnerability (%)		P-value
		Not underestimating	Underestimating	
Household head				
Female head	92	30.4	69.6	<0.001
Male head	119	63.0	37.0	
Formal education				
No education	34	35.3	64.7	0.027
Primary education	36	36.1	63.9	
Secondary and above	141	55.3	44.7	
Migration status of head				
Migrant	137	49.6	50.4	0.746
Non-Migrant	74	47.3	52.7	
Employment status				
Not Employed	46	23.9	76.1	<0.001
Employed	165	55.8	44.2	
Marital status				
Married /living together	104	53.8	46.2	0.149
Not married	107	43.9	56.1	
Religion				
Traditional/Spiritualist/ No religion	19	63.2	36.8	0.348
Christianity	159	48.4	51.6	
Moslem	33	42.4	57.6	
		Mean ± SD		
Age of household head (in yrs.)		41.65 ± 11.3	48.7 ± 18.7	0.001

* implies significant at 10%; ** implies significant at 5%; *** implies significant at 1%.

Empirical models and results

A logistic regression is estimated to investigate possible determinants of household heads underestimating their vulnerability to floods³. The empirical equation to be estimated was underestimating function, which is a logit regression. The underestimating equation, which is equivalent to the equation below, is specified as:

³ A probit regression could be employed as well. The main difference between the two methods is that the logistic distribution has a flatter tail hence the variance of the standard normal and logistic distributions has different variances but the same mean of zero. Results from the two regressions can be compared if the coefficients of the probit are multiplied by 1.81

$$\text{Underestimating} = f(\text{SexH}, \text{Edu}, \text{MS}, \text{Work}, \text{Marital}, \text{Religion}, \text{AgeH}, \text{AgeH}^2) \text{-----5.1}$$

The dependent variable is binary; taking the value 1 if the household head underestimates household vulnerability to floods and 0 if otherwise. The explanatory variables were the sex of household head (*SexH*), formal education of household head (*Edu*), migration Status (*MS*) employment status (*Work*), marital status (*Marital*) and age of household head (*AgeH*). The addition of the age squared (*AgeH*²) to the equation permits the modelling of the effect of the differing ages, rather than assuming the effect to be linear for all ages. All explanatory variables except for the age of household head were entered as binary variables.

Results of overall logistic regression

The determinants of underestimating a household's vulnerability (for the overall sample with both male and female headed households) are presented in Table 5.6. The F-statistic shows that the regression is a good fit at 1% significance level ($P < 0.001$). The logistic regression coefficient gives the change in the Log odds of the outcome for a one-unit increase in the predictor/independent variables. The sex of household heads, the age of household, the square of the age of household and being a Moslem were statistically significant predictors ($P < 0.001$, $P = 0.002$, $P = 0.001$, $P = 0.001$ and $P = 0.082$ respectively) of household heads underestimating the vulnerability of their households to floods.

- Female household heads were more likely to underestimate their household vulnerability.
- A quadratic relationship was found between the age of household head and underestimation of vulnerability. The nature of the relationship indicates that the likelihood to underestimate vulnerability to floods decreases as the age of a household head increases up to a turning point (45 years) beyond which household heads are more likely to underestimate

- The employment status, migration status and marital status of the household head did not influence their estimation, specifically underestimating their vulnerability to floods.

Table 5. 6 Logit regression of determinants of household underestimating their vulnerability

Explanatory variables		Coef.		SE	P-value
Sex of household head					
Female head	(=1, 0 otherwise)	1.324	**	0.375	<0.001
Marital Status					
Married /living together	(=1, 0 otherwise)	0.404		0.349	0.248
Employment status of household head					
Head employed	(=1, 0 otherwise)	-0.771	*	0.445	0.118
Migration Status					
Migrant		8.81 X 10 ⁻⁵		0.344	1.000
Age of household head					
Age in years (AG)		-0.263	**	0.001	0.002
AG²		0.003	**	0.001	0.001
Formal education of household head					
No education: Ref					
Primary education	(=1, 0 otherwise)	0.832		0.620	0.167
≥Secondary education	(=1, 0 otherwise)	0.194		0.517	0.708
Religion					
Traditional/Spiritualist/No religion: Ref					
Christians		0.545		0.611	0.372
Moslems		1.200		0.689	0.082
Constant		4.083		1.783	0.007
Pseudo R ²		0.192			
Prob > chi2		>0.001			
Number of observation		211			

Asterisks indicate significant levels: * implies significant at 10%; ** implies significant at 5%; *** implies significant at 1%.

Models by Sex (Female headed household and Male headed households)

Although targeting female-headed households with the aim of reducing poverty remains contentious (Rajaram, 2009), admittedly, female-headed households are likely to face or have faced some elements of gender discrimination relating to earnings, rights, and economic

opportunities (Barros et al. 1997). This assertion is corroborated by the comparison of some key demographic indicators in the study area by the sex of household heads. Thus, considering the significant gender differences and interest in gendered vulnerability, Table 5.7 presents an exploration of the different predictors for underestimating household vulnerability among female-headed households separately and among male-headed households.

The first column of Table 5.7, which is denoted (1), presents the regression results of the predictors of underestimating household vulnerability among female household heads only. The results show that among female household heads;

- Those married were more likely to underestimate their vulnerability compared to their unmarried counterparts ($P=0.045$).
- Employed female household heads were significantly less likely to underestimate their vulnerability ($P=0.028$).
- Female household heads with secondary education-compared with no education- and Moslems female heads, compared with Traditional/No religion were more likely to underestimate their vulnerability ($P=0.058$ and 0.032 , respectively).

The second column of Table 5.8, which is denoted (2), presents the regression results of the predictors of underestimating of vulnerability among male-headed household only. Results indicate that among male heads;

- Migrants were less likely to underestimate their vulnerability compared to non-migrants.
- Age showed to be a significant predictor of underestimating vulnerability with a quadratic function. Considering the coefficients of the age variable and it's squared, a turning point of 45 years was calculated. This implies that with increasing age, male

heads were less likely to underestimate their household vulnerability to floods until after 45 years. Beginning from 45 years, male household heads were more likely to underestimate their vulnerability.

Table 5. 7 Logit regression of determinants of household underestimating their vulnerability by sex of household head

Dependent Variables	(1)			(2)		
	Coef.	SE	P-value	Coef.	SE	P-value
Marital status						
Married/ living together (1, 0= otherwise)	1.434**	0.715	0.045	0.512	0.505	0.311
Migrant (1, 0 otherwise)	1.819**	0.689	0.008	-1.063**	0.482	0.028
Employment status						
Employed (1, 0 otherwise)	-1.799**	0.817	0.028	-0.427	0.678	0.529
Age of household head						
Age of head in years (Age)	0.002	0.001	0.126	-0.451***	0.136	0.001
Age ²	-0.117	0.116	0.317	0.005***	0.001	0.001
Formal education of H head						
No formal education (Ref)						
Primary (1, 0 otherwise)	0.932	0.867	0.283	2.302**	1.075	0.037
≥Secondary (1, 0 otherwise)	1.450	0.763	0.058	0.195	0.920	0.839
Religion						
Traditional/Spiritualist/No religion (Reference)						
Christians	0.864	1.099	0.432	0.671	0.739	0.364
Moslems	3.415**	1.592	0.032	1.039	0.844	0.218
Constant	-0.389	2.832	0.891	8.597	2.777	0.002
Pseudo R2		0.247			0.213	
Prob>Chi2		0.001			0.0001	
Number of observation		92			119	

Asterisks indicate significant levels: * implies significant at 10%; ** implies significant at 5%; *** implies significant at 1%.

5.4 Discussion

The results from this chapter advance the researcher's understanding of the characteristics of households contributing to their own estimation of vulnerability to floods. Specifically, given the consequence of a household underestimating its vulnerability to hazards such as floods, for example, reducing preparedness and /or increasing the likelihood of harm, this chapter investigated selected household and household heads characteristics that influence underestimation of households to flooding. Underestimating a household vulnerability may be driven by the lack of knowledge of the degree of risk or an improved capacity to deal with that risk.

Sex of household head

Traditionally women and men differ with regard to their perception and reaction to climatic hazards such as floods (Roehr, 2007). Generally, men are considered 'risk takers' and women considered 'risk avoiders' (Harris et al., 2006). This consideration emanates from literature suggesting that compared to their male counterparts, females place a higher value on personal health and well-being and also tend to have heightened fear of natural disasters. Other reasons are linked to the caregiving roles of women, hence they tend to "worry" more about their family, particularly children in the advent of disasters (Lovekamp, 2006). Thus, it is usually hypothesised that females will be less likely to underestimate their vulnerability to natural hazards.

The above notwithstanding, female household heads in this study were approximately 4 times (Odds Ratio: 3.75) more likely to underestimate their vulnerability to floods compared to their male counterpart. Although considered more vulnerable, beyond sex, factors such as women's marital status, social status, economic status and religion do modify discriminations encountered (UN Women, 2015). Studies showing the disparate impact of natural disasters on women allude to gendered differences in their ability to cope or adapt due to an array of socio-economic,

demographic and cultural differences. They usually find themselves in the lower wealth or access to economic resource category; have a lower level of education and poorer access to information. Women are also inclined to live and work closely in disaster-prone locations; and that some socio-cultural customs may lead to restrictions in the movement to escape disasters (Ciampi et al., 2013). A similar study showed that at-risk women, having experienced several floods without any major problems in the past were likely to underestimate the catastrophic nature of floods (Sato et al., 2015). Furthermore, Botzen et al 2009 also found that women in their study expected to suffer less flood damage than their male counterparts (Botzen et al., 2009). Thus vulnerability to floods needs to be discussed in its context while acknowledging that poverty and gender discrimination add to the complexity of perceived vulnerability (Shaw et al., 2013). Also, while flood consequences such as deaths and destruction of property may be easily quantifiable, its impact on illness may be more complicated and may not be easily factored in by households when evaluating their vulnerability or risk.

This study indicates that among female-headed households, being married as well as muslims were both independently more likely to underestimate their vulnerability (Table 5.7). This outcome may possibly be due to support received from partners and religious groups. These findings support those from studies that assert that lone mothers and/or single women are likely to be more vulnerable to economic or environmental shocks, on account of the impediments faced by females in accessing economic resources required for recovery and survival (Cutter et al., 2009). Thus, with the likely support from partners in the advent of floods, these women may underestimate their vulnerability to the climatic hazards, in this case, floods. A similar observation is recorded for women living with landslide risks but tends to underestimate how vulnerable they were (Kusakabe et al., 2015).

Furthermore, men have been identified in some instances to exhibit different help-seeking behaviour that might make them perceive themselves more vulnerable compared to their female heads. Example, men are often more embarrassed to seek help. Such a situation is exemplified in the reported scenario below.

“In 2001, the flood destroyed her husband’s wet season rice crop. He asked [his wife] to borrow money from the private money lender so that they could buy some new seed stock and fertiliser. Her husband would not go because he felt embarrassed to talk to the money lender” (Flood Impact on Women & Girls in Prey Veng Province, Cambodia,” CARE International, 2002.)

Although the above scenario was not investigated in this study, such conditions (the reduced likelihood of help-seeking by men and increased likelihood of the same among women) may contribute to female household heads underestimating their vulnerability to floods compared to male heads. Data collected for this study indicates that the proportion of female household heads reporting that they can rely on support from relatives and friends was significantly more than the proportion of males who could rely on support from relatives and friends (65.3% vs. 50.3%; $P=0.014$). Thus, the female heads may underestimate her vulnerability based on an increased possibility of receiving help in time of trouble.

Age of household head

The inclusion of age and the square of age (household head’s age) in the logistic function was to test for a possible quadratic relationship between age and underestimation of vulnerability. The relationship shown by the results indicates that older males (above approximately 45 years) were more likely to underestimate their vulnerability to floods.

Plausible reasons for this observation could be that the older males are familiar with floods in their localities and may have found appropriate coping or adaptation strategies to deal with the phenomenon over a period. This result is in synchrony with others that have indicated that greater experience with flooding leads people to underestimate the associated risk (Chomsri and Sherer, 2013, Działek et al., 2013). Also, the older males may have built better social capital to deal with eminent floods compared to their younger counterparts thus underestimating their vulnerability.

Employment status

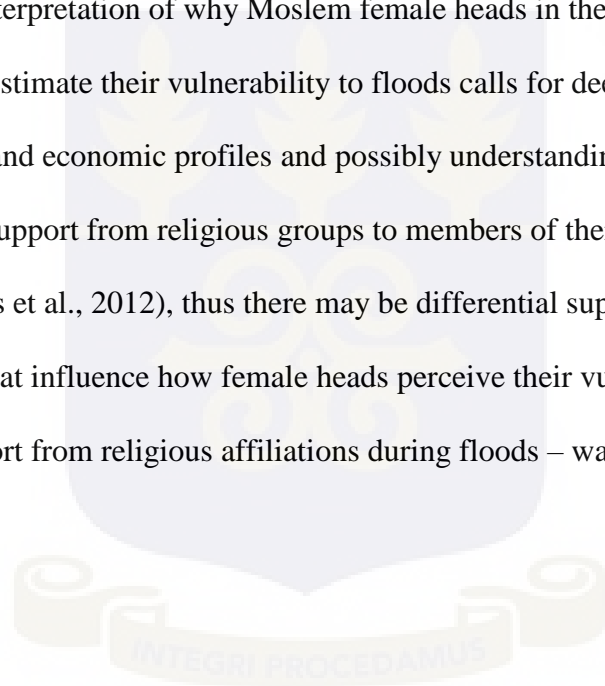
Generally, disasters such as floods have the potential of pushing the non-poor into poverty and the poor into destitution. Given that women's longer-term vulnerability may be dependent on resource/income from her employment, it makes sense for those employed to underestimate their vulnerability compared to those who are not employed. This trend could be more associated with female heads than male heads as they are usually poorer. However, data to substantiate the differential effect of floods on female and male household heads over time and impact on their vulnerability are largely missing.

Formal education

Education, especially formal education, can moderate risk perception via improved skills and access to information and resources. For female heads, it is possible that those with secondary and or above education may have enhanced coping strategies in the aftermath of a natural disaster due to greater flexibility and more varied skills to have alternate income generating activity compared to their counterparts with lower levels and no education (Muttarak and Lutz, 2014b). Education's impact on perceived vulnerability was different among female and male household heads indicating the existence of more unexplained gender nuances in this relationship.

Religion

More than a few studies have shown that religious affiliation influences traumatic reactivity (Dewey III, 1988, Walls and Zarit, 1991). The interest in the role religion plays in disaster management has gained some attention because religion influences how people perceive or manage disasters (Kyoo-Man, 2015). Comparable to culture, religion cannot be isolated from the broader portrait of risk mitigation, as it continuously interacts with economic, social and political constraints in the formulation of perceived vulnerability of a population (Chester and Duncan, 2010). Thus, a correct interpretation of why Moslem female heads in these study communities are more likely to underestimate their vulnerability to floods calls for deeper investigations into their sociodemographic and economic profiles and possibly understanding Islamic teachings on disasters. Additionally, support from religious groups to members of their congregation is not a new phenomenon (Coles et al., 2012), thus there may be differential support received from mosques and churches that influence how female heads perceive their vulnerability to floods. This information – support from religious affiliations during floods – was, however not explored.



CHAPTER SIX

THE RELATIONSHIP BETWEEN HOUSEHOLD VULNERABILITY AND COPING/ADAPTATION STRATEGIES

6.0 Introduction

Ghana is ranked high among flood vulnerable countries and has developed a number of policies to address flooding (Danso and Addo, 2016). For example, the National Water Policy was formulated, among other things to guide the establishment of an early flood warning system while the 'Blue Agenda' addresses flooding and other related dangers specifically. The Environmental Sanitation Policy of 2012 was also drafted to ensure a clean environment, including the frequent clearing of drains. Despite the articulation of relevant policies to guide this sector, Ghana is yet to successfully deal with both the prevention and impact of floods.

Although autonomous adaptations may be inadequate in dealing with floods, thus requiring planned adaptation measures (Filatova, 2014), examining how individuals in these risky areas cope with floods and most importantly, how different levels of vulnerability influence their coping strategies will be critical in guiding national policies and local strategies. This is because the accrued capacity at the household or local level is increasingly acknowledged to be important in enhancing resilience and transformation (Wamsler and Brink, 2014). The above, notwithstanding, there is a paucity of information on the coping strategies of resource-poor households even though they bear the brunt of flood impacts.

This penultimate chapter identifies firstly, the various coping strategies households embark on in the event of floods and secondly how the varying degrees or levels of the major components of households' vulnerability predict the choice or selection of household coping strategies.

6.1 Households coping strategies to flood.

Households employ a wide range of coping strategies to reduce their level of risk to floods. Figure 6.1 shows the various coping strategies households embark on because of flooding in study communities. Although these households lived in flood risk areas majority of the households reported doing nothing to cope or adapt to the floods. They simply ‘survive’ it. About a third had to reconstruct or maintain their houses/building to cope with the floods. Thirty-four percent of the households also engaged in clearing of drains as a coping strategy to floods.

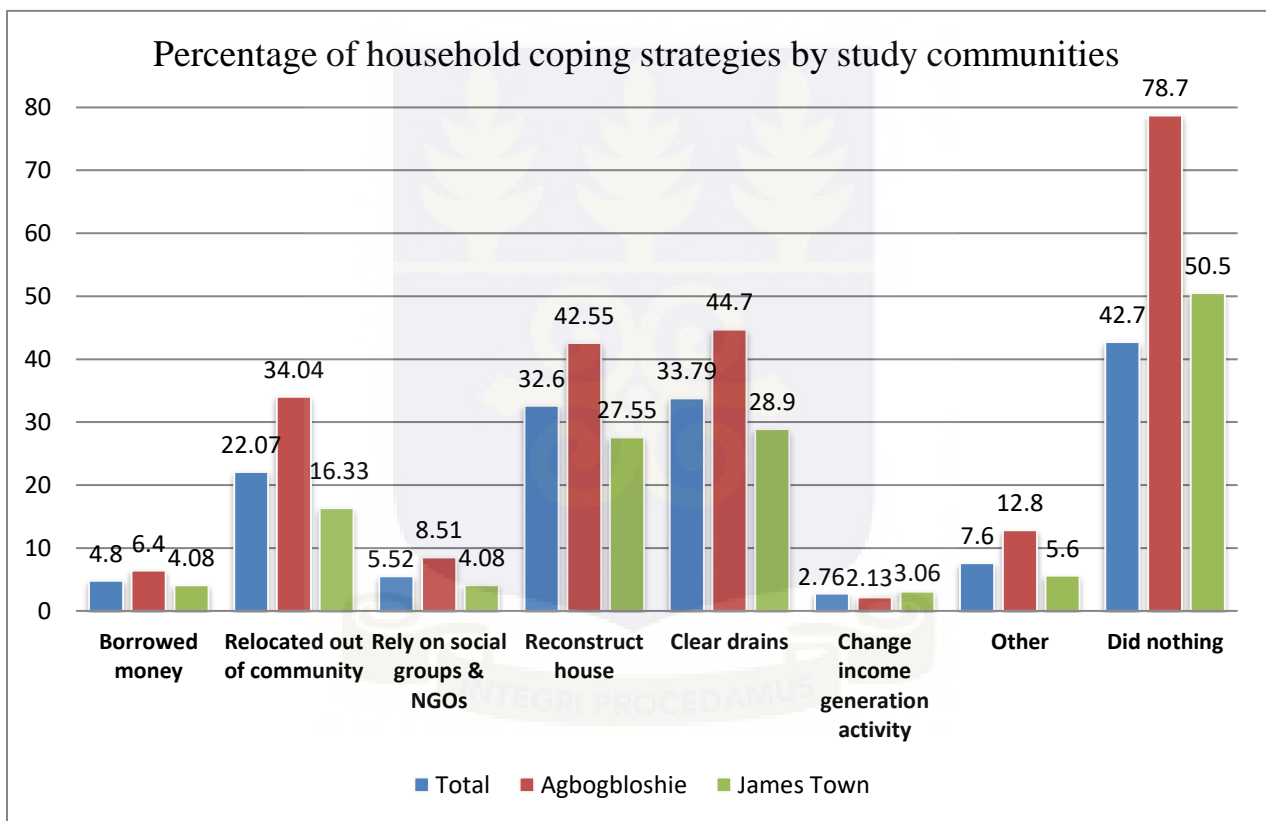


Figure 6. 1: Percentage of household coping strategies by study communities

The least reported coping strategy was changing ones’ income generation activity to cope with floods. A little over a one-fifth (22.2%) also relocated temporarily to be with family and friends outside the communities as their coping strategy. Significantly more households relocated as a coping strategy in Agbogbloshie compared to households in James Town (P=0.018) and more

households reported to have engaged in no coping strategy in Agbogbloshie compared to James Town (P=0.001). Table 6.1 gives examples of the various coping and adaptive practices for floods.

Table 6. 1 Coping and adaptation practices to floods

Coping and adaptive practices for hazard-Floods	
Coping strategy	Illustrative examples (including effective and ineffective practices)
Borrow money	Household heads reported having borrowed money for family upkeep because of the floods
Relocated	Relocated out of the community to live with friend and /or relatives, mostly to a neighbouring community
Rely on social groups	Relied on support from religious groups such as churches and Mosques and non-governmental organisations
Reconstruct house	This involves repairing and strengthening building structures affected by floods and also prevent further damages
Clear drains	De-silting the poor drainage system in the community near households to facilitates the easing of pressure of floods on the households
Changed income generating activity	Diversify income to reduce potential hazard impacts.
Did nothing	These households did nothing to cope with floods

6.2 Relationship between coping strategy and major components of vulnerability

The various components of adaptive capacity, sensitivity and exposure may influence a household's ability or choice of a coping strategy and influence the choice or ability to select one coping strategy or another. Natural disasters such as floods are increasingly becoming a leading cause of displacement or temporary relocation of many inhabitants. The study investigates the relationship between the various component of a household's vulnerability and (i) embarking on any coping and /or adaptation (ii) specifically using relocation as a coping or adaptation.

Table 6. 2 Descriptive Statistics of the major components of vulnerability used for the regressions

Component of vulnerability	Relocated (n=32)		(1) Did not relocate (n=113)		No coping strategy (n=83)		(2) Coping strategy (n=62)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Adaptive capacity								
Socio-demographic profile	0.28	0.19	0.32	0.19	0.30	0.18	0.32	0.19
Livelihood strategy	0.29	0.37	0.31	0.32	0.29	0.33	0.34	0.33
<i>Social capital</i>	0.25 ^c	0.23	0.33	0.23	0.33	0.24	0.30	0.23
Sensitivity								
Health	0.28	0.23	0.26	0.22	0.25	0.22	0.29	0.21
Water and sanitation	0.33	0.27	0.38	0.23	0.38	0.26	0.36	0.23
Food	0.27 ^b	0.25	0.14	0.20	0.29 ^b	0.23	0.13	0.19
Exposure								
Climate variability	0.26 ^c	0.44	0.14	0.33	0.20	0.38	0.12	0.31
Overall Vulnerability	0.28	0.13	0.28	0.10	0.29	0.11	0.28	0.10
Another predictor(s)								
Migration status %								
Migrants		31.7 ^a		68.3		61.4		50.0
Non-migrants		9.5		90.5		38.6		50.0

All values represent Mean and SD except otherwise indicated: Significant levels: ^c implies significant at 10%; ^b implies significant at 5%; ^a implies significant at 1%.

Table 6.2 describes the mean scores of the various major and minor components of vulnerability in the equation by coping strategy (**Column 1**): ‘Relocation’ as a coping strategy vs. ‘Not Relocating’; **Column 2**. Adopting any coping strategy vs. Not adopting any strategy)

Column 1 of Table 6.2 shows that:

- Significantly, more migrants’ households relocated as a coping strategy compared to non-migrant households (31.7% vs. 9.5%; P=0.001).
- Households relocating as a coping strategy had a significantly greater mean food vulnerability score compared to those not relocating (0.27 SD 0.25 vs 0.14 SD 0.20;

$p=0.006$). In other words, relocating households were more food insecure than households that do not relocate.

- The social capital vulnerability score for households that relocate as a coping strategy was less than those who do not relocate (0.25 SD 0.23 vs. 0.33 SD 0.23; $p=0.081$). This implies relocating households had better social capital than their counterparts who do not.
- Households that relocate as a coping strategy were also more exposed to floods than those who did not relocate (0.26 SD 0.44 vs. 0.14 SD 0.33; $p=0.028$).

Column 2 of Table 6.2 shows the mean difference between the vulnerability scores of the various components of household vulnerability by whether a household embarked on any coping strategy. Specifically, the study found that:

- A significant mean difference between the two groups (embarked on a coping strategy vs. no coping strategy) was identified only for the food component of the household vulnerability. Significantly, households that do not embark on any coping strategy were more vulnerable with respect to food (more food insecure) than those that employ some form of coping strategy (0.29 SD 0.23 vs. 0.13 SD 0.19; $p=0.039$).

Empirical model and results

The empirical model

A logistic regression is estimated to investigate possible determinants of relocating as a coping strategy. The empirical equation to be estimated was relocation function, which is a logit regression. The relocation equation, which is represented by the equation below:

$$Relocation = f(SEP, LS, SC, HTH, WS, FDS, CV, MIG) \text{-----} 6.1$$

The dependent variable is binary; taking the value 1 if the household relocated as a coping strategy because of flooding and 0 if otherwise. The explanatory variables were the various contributing

components of overall household vulnerability - the sociodemographic profile (*SEP*), livelihood strategy (*LS*), social capital (*SC*), health status (*HTH*), water and sanitation situation (*WS*), food situation (*FDS*), climate variability (*CV*), and migration status (*MS*). All independent variables serving as components of household vulnerability were continuous variables. Greater values of the index of the vulnerability component meant a household is more vulnerable. For example, a household with a Health vulnerability score of 0.23 is more vulnerable to floods with respect to the health indicators than a household with health vulnerability score of 0.20. An increasing value denotes increases vulnerability. The migration status was a binary outcome - migrants had a value of 1 and non-migrant a value of 0.

Results of logistic regression

The relationship between sub-components of vulnerability and coping/adaptation strategies

Before determining the relationship between the major vulnerability components – sociodemographic profile (*SEP*), livelihood strategy (*LS*), social capital (*SC*), health status (*HTH*), water and sanitation situation (*WS*), food situation (*FDS*), climate variability (*CV*) – with the coping/adaptation strategies, Table 6.3 explores the relationship between the subcomponents or indicators with the coping/adaptation strategies.

Column 1 of Table 6.3 shows the logit regression result of predictors of whether a household embarked on any coping or adaptation strategy or strategies against floods. The likelihood ratio chi-square of 37.80 with a p-value of 0.0094 indicated that the model fits significantly better than an empty model. The table reveals that an increase in household age significantly increases the log odds of engaging in some coping/adaptation strategy. Households without brick/cement walls and those without mosquito-proof screens were more likely to engage in some coping/adaptation

strategy. However, the more food insecure a household was (represented by the inverse of the average number of meals taken by household a day), the less likely that household will engage in a coping/adaptation strategy.

Column 2 of Table 6.3 shows the logit regression result of predictors of whether a household relocated as a coping strategy against floods. The likelihood ratio chi-square of 73.16 with a p-value of <0.0001 indicated that the model fits significantly better than an empty model. As shown in the table,

- Households without brick/cement were less likely to relocate.
- Households that cannot rely on receiving any support were less likely to relocate
- The more food insecure a household is, the more likely that household will relocate
- Migrants were more likely to relocate.

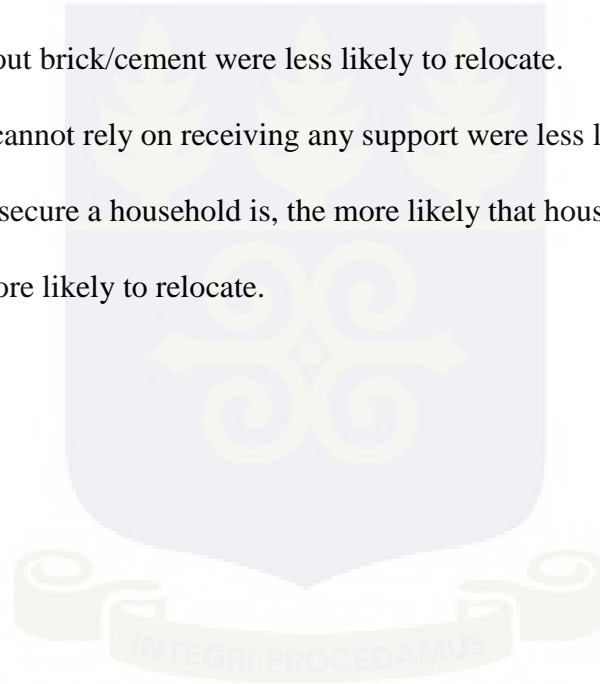


Table 6. 3 Logit regression of determinants– sub-component of vulnerability– of households coping / adaptation strategies to flood

Indicators	1		2	
	Coping		Relocate	
	Coef.	SE	Coef.	SE
Socio-demographic profile				
H head age in years	0.025	0.014 ^a	-0.055	0.027
Female-headed H	0.268	0.429	0.282	0.712
H Head with no primary education	-0.26	0.594	-0.728	0.988
H with building material not Brick/cement	1.184	0.577 ^b	-2.343	0.871 ^b
Want parameter	-0.17	0.164	0.692	0.301 ^b
Livelihood strategies				
H members not employed	0.01	0.007	-0.021	0.012 ^a
H heads with no occupation	-1.07	0.689	1.872	1.024 ^a
Social capital				
Average receive: give ratio	-0.01	0.229	-0.750	0.530
H cannot rely on receiving support	-0.18	0.439	-1.666	0.737 ^b
Health				
Inverse of time taken to the nearest hospital/health	18.03	11.078	-15.048	14.188
H with diarrhoea cases over the past month	0.215	0.489	0.423	0.707
H with no windows covered with mosquito-proof screens/net	0.793	0.442 ^a	-0.880	0.712
Water and Sanitation				
H with no indoor pipe or improved water source	-0.21	0.492	0.430	0.742
H without daily supply of water	-0.08	0.616	-1.569	1.846
H without improved toilet	-0.17	0.487	-1.326	0.746 ^a
Food				
H did not have enough food to eat in a day or more over the past month	0.39	0.586	0.285	0.802
Inverse Average number of full meals taken by H members	-52.4	14.103 ^c	63.511	18.733 ^c
Climate variability				
Experience flood in neighbourhood	0.746	0.847	-2.078	1.418
H affected by flooding	-0.54	0.988	2.491	1.597
Migration Status				
Constant	18.44	5.411	-26.453	6.836
Prob > chi2		0.0094		<0.001
Pseudo R2		0.1909		0.4780

Significant levels: ^a implies significant at 10%; ^b implies significant at 5%; ^c implies significant at 1%.

The relationship between major components of vulnerability and coping /adaptation strategies

The likelihood ratio chi-square of 28.64 with a p-value of 0.0004 as shown in Table 6.4 implies that the model fits significantly better than an empty model (i.e., a model with no predictors).

Households' sociodemographic, social capital, food security and migration status were statistically significant predictors (P=0.085, P=0.010, P=0.014 and P=0.005 respectively) of households relocating after floods.

Table 6. 4 Logit regression of determinants– major components of vulnerability– of households relocating in response to flood

	Coef.		SE	Sign. level
Vulnerability components				
Sociodemographic profile	-2.36	*	1.37	0.085
Livelihood strategy	-0.59		0.71	0.405
Social capital	-2.66	**	1.03	0.01
Health	-0.18		1.02	0.861
Water and sanitation	-1.49		0.98	0.129
Food	2.43	**	0.98	0.014
Climate variability	0.79		0.60	0.187
Other				
Migration status	1.53	**	0.54	0.005
Constant	-0.72		0.69	0.292
Pseudo R2	0.1871			
Prob > Chi2	0.0004			
Number of observation	145			

Note that the asterisks indicate significant levels: * implies significant at 10%; ** implies significant at 5%; *** implies significant at 1%.

- The sign of the coefficient of sociodemographic vulnerability is negative; meaning that for a unit increase in socio-demographic vulnerability, the log odds of relocating (versus not relocating) decreases by 2.35. In other words, the more vulnerable a household is with

respect to their sociodemographic profile, the less likely the household will relocate as a coping strategy to floods.

- The sign of the coefficient of **social capital vulnerability** is negative; meaning that for a unit increase in social capital, the log odds of relocating (versus not relocating) decreases by 2.66. This implies that the more vulnerable a household is with respect to social capital (households with poor social capital), the less likely a household will relocate as a coping strategy after floods.
- The sign of the coefficient of **food security vulnerability** is positive; meaning that for a unit increase in food insecurity, the log odds of relocating (versus not relocating) increases by 2.43. This implies that the more vulnerable a household is with respect to food security (households that are more food insecure), the more likely a household will relocate as a coping strategy after floods.
- The sign for the **Migration** status is positive; this means that migrants compared to non-migrants are more likely to relocate during floods as a coping strategy.

6.3 Discussion

Coping strategies

The various coping and adaptive practices of households that households employed were meant to help households to withstand and /or recover from the impact of floods. Some households are unable to afford the cost of repair, reconstruction, or relocation resulting in borrowing from friends and relatives to help cope with the situation. Considering that flood insurance is basically non-existent in these communities, borrowing from friends and family may serve as a pivotal strategy which enables households to deal particularly, with physical damage to their properties and possible interruption to their businesses. Although the success of such coping strategy was not

addressed in this study, there is compelling evidence which suggests that the transfer of cash to households affected by disasters yields some success (Adams and Winahyu, 2006). The study results corroborate others which reported that relying on social groups, clearing of drains, reconstruction of house and change of income generating activities as coping/adaptive strategies to floods (Danso and Addo, 2016, Kates et al., 2006, Pooyan, 2004).

Vulnerability indicators and relocating as a coping strategy

Whether permanent or temporary, relocation/migration has always been an alternate response or coping strategy of households in the aftermath of disasters (Hugo, 1996). The concept of vulnerability and coping strategies, specifically a household relocating/migrating from their usual place of abode seeks to address the totality of the relationship between a household's social, economic and cultural situation, which facilitates the leaving or staying at a locale in the event of a disaster, in this case, floods. This study shows that some major contributing components of the households' adaptive capacity and sensitivity are inherently more likely to engender adaptive relocation. Both the sociodemographic and social capital components of adaptive capacity were significant negative predictors of relocation. Thus, the more vulnerable households are, with respect to their sociodemographic profile, the less likely they are to relocate. Likewise, households with more social capital are more likely to relocate as a coping strategy.

Whiles disasters such as floods are thought to trigger temporary or permanent relocation/migration, there is a complex array of multi-causal factors - including individual, social, economic and political that leads to a household decision and/or ability to relocate (Black et al., 2013, McLeman and Smit, 2006, Hunter, 2005). The association between the experience of climatic stressors such as flooding, and relocation is very diverse.

Relocation can be expensive. This is particularly so if significant earthworks and infrastructure are needed to go to the targeted destination areas (Campbell et al., 2007). Traveling cost and the legality associated with settling at the alternate destination can also influence whether households that have experienced a climatic stressor, such as flood relocates. The fact that in this study, households with higher vulnerability scores with respect to sociodemographic profile (poorer households) were less likely to relocate may be indicative of such households' inability to afford to relocate to another place (Nawrotzki and DeWaard, 2017). This observed relationship corroborates the synthesis of Black et al (2013) which stipulates that households of low to medium sociodemographic profile are often trapped in situ during disasters or where they have been displaced, following a disaster.

For the very poor, climate hazards such as flooding could mean double jeopardy. Not only do they experience worsening surrounding environmental conditions but also floods may affect their livelihoods in a very negative way (Xu et al., 2009). The livelihoods of the poor are often tied to or more specifically in the closest proximity to their home. Thus, uncertainties associated with the outcome of their livelihood at the alternate destination may hinder them to readily relocate even in the face of the harshest stressor, in this cases flooding.

Also, contrarily to expected movement of the hardest hit individual to move away from disaster prone locations, relocation is motivated also by the 'sense of place' (place attachment). For example, Mishra et al.'s (2010) study found that the place of attachment significantly influences flood preparedness and relocation among the vulnerable. In this study, migrants were also more likely to relocate as a coping strategy. Although not ascertained, these migrants (unlike non-migrants) may have an alternate locality of abode (such as their 'home' communities) to take/ seek shelter in the aftermath of disasters such as floods. A non-migrant household may not be as easily

triggered to relocate even when faced with the same exposure (flood) as a migrant household. Therefore, households who live in flood-prone areas or face floods may not relocate not only because of the lack of resources but simply because of a place attachment

The relocation of households after natural disasters such as flooding dependent on their social capital and network (Hurlbert et al., 2001). The result of this study corroborates with this assertion. More vulnerable households with respect to social capital were less likely to relocate due to flooding. Individual households could rely on available social capital to support to ... relocate. Similarly, a study conducted in Japan found out that after the experience of two natural disasters improved informal socializing and social participation was associated with group relocation (Hikichi et al., 2017).

Households more vulnerable to food insecurity were more likely to relocate. Since food is a fundamental need for survival, households that are more food insecure were more likely to relocate out of the community as a matter of survival in search for food as a result flooding. Degraded living conditions as well as environmental disasters have long been associated with human migration to more prosperous locations for food (Adler and Gielen, 2003).

Much broadly, scholarship on the environment-migration nexus suggests that sudden-onset natural disasters always trigger large-scale human displacements which disproportionately affect the poor and vulnerable (Myers, 2002, Parry et al., 2007). Results from this study support the importance of the various components of households' adaptive capacity in modulating the mobility of households under stress than the pro 'Neo-Malthusian' position that environmental disaster will eventual drive mobility.

CHAPTER SEVEN

SUMMARY, CONCLUSION AND RECOMMENDATION

7.0 Introduction

The global climate has changed and contributed to an increase in both frequency and intensity of natural disasters. That climatic stressor such as floods disproportionately affects households in resource-poor communities is less contested. The varying degrees of vulnerability of households is however modulated by their unique characteristics which determine the extent to which each household anticipates, copes and recovers from the impact. Thus, vulnerability assessments in resource-poor communities such as Agbogbloshie and James Town have become imperative due to the presence of multiple social, economic and biophysical stressors.

This study was a cross-sectional study. Employing up-to-date literature on factors influencing the vulnerability to floods, this study identified various measures of household vulnerability. A community household survey was used to collect information needed to compute a household vulnerability index in line with the IPCC definition of vulnerability. The computed household vulnerability was then compared to the household's own perceived vulnerability to floods. Comparing perceived vulnerability to the households' computed vulnerability, the characteristics and predictors of households that underestimate their vulnerability was ascertained. Given the prospect of households (in) actions before, during and after flooding being influenced by existing characteristics, the study examined the relationship between the various vulnerability components – sociodemographic profile, livelihood strategies, social capital, health, food, water and sanitation and climate variability - of households and selected coping strategies to floods. Hitherto, this has not been explored adequately in both vulnerability and adaptation research.

7.1 Summary of results and conclusion

Relevant theory in concurrence with available data informed the computation of scores for minor components - Socio-demographic profile, livelihood strategies, Social capital, Health, Food, Water and sanitation and Climate variability- of household vulnerability to floods. These were further aggregated to represent the major components – adaptive capacity, sensitivity and exposure.

The study results indicate that households in Agbogbloshie were significantly more vulnerable with respect to their sociodemographic profile, social capital, health, food and climate variability indexes compared to their counterparts in James Town. James Town was in-turn more vulnerable with respect to livelihood strategies. There was no significant difference between the two communities pertaining to their water and sanitation vulnerability score. As expected, the households in Agbogbloshie community were overall more vulnerable to floods than their counterparts in James Town community. Considering vulnerability as a function of adaptive capacity, exposure and sensitivity, Agbogbloshie was cumulatively more exposed and also more sensitive to floods than James Town. The two communities did not differ with respect to their adaptive capacity to floods.

Comparing perceived vulnerability and computed vulnerability to floods showed that a little over half of the household heads (51%) underestimated their vulnerability. Unexpectedly, female household heads were shown to be more likely to underestimate their households' vulnerability to floods. Interested in gender-specific predictors for underestimating vulnerability, the study data was disaggregated into male and female-headed households. Further analysis revealed differing factors predicting household heads (Males versus Females) likelihood to underestimate their vulnerability. For female heads; being married, migrant and being a Moslem compared to no religion and Traditionalist independently predicted the likelihood of underestimating their

vulnerability. Female heads that were employed were less likely to underestimate their vulnerability. For male heads, migrants were less likely to underestimate their vulnerability. In addition, household heads beyond 45 years were more likely to underestimate their vulnerability.

Results of this study showed that households affected by floods employed the following as coping strategies; borrowed money, relocated temporarily out of the community, relied on social groups and non-governmental organisations, reconstructed house, cleared drains and, changed income generation activity. Clearing of drains and reconstruction of houses to withstand or deal with flood impacts were the two most coping strategies employed by households. About 43% of the households in the two communities did not embark on any coping strategy against flooding.

Placing the different coping strategies on a continuum, temporary or permanent relocation happens to be at the extreme end. Findings suggest that the relocation of households as a coping strategy to floods is influenced by their sociodemographic profile, social capital and migration status. Migrant households were more likely to relocate as a coping strategy. An increase in the socio-demographic vulnerability and social capital vulnerability were both independently associated with the likelihood of not relocating. An increase in vulnerability with respect to food increased the likelihood of relocating as a coping strategy to floods.

7.2 Recommendation

Generally, investments in adaptation and coping strategies to lessen the impact of climatic stressors such as floods are increasingly being acknowledged as critical and complementary to mitigation efforts. The success of adaptation and coping strategies depends first on carefully assessing the different features of the systems – country, community and, households – vulnerability, in order to guide effective interventions.

Although relocation or moving away from flood-prone communities such as some sections of Agbogbloshie is arguably a good protection from flooding and its impacts, relocation has proved not to be the most feasible. Relocation may even be disruptive for households in these communities. Based on the findings of this study the following recommendations are made:

Social interventions

That, more than half of the household heads underestimated their vulnerability to floods suggests that there is some misrepresentation about the impact of the floods. It is also possible that many individuals may be living in denial of the impact of floods. While the consequences of poor sanitation practices or weak infrastructure may be available to scientists and development planners, the gravity may not be fully realised by local stakeholders and community members. A key element of any risk or vulnerability reduction program is firstly making the populace aware of the impact of the climatic hazard. There could be concerted effort to increase or improve public awareness of the dangers of living in flood-prone areas such as current study sites.

A correct estimation of vulnerability could promote rightly both autonomous and planned adaptation strategies. There are examples where public education programs have reduced considerably the impact of natural disasters such as floods. Given that the study found significant difference household perception of their vulnerability and computed vulnerability, it is imperative that any intervention should involve the community members in its formulation and implementation. This will ensure community support and participation. Such participatory approaches bring to the fore how community members conceptualise their vulnerability, thus dealing with it more effectively. The success of public education programmes may also need a more favourable political environment to facilitate behavioural change.

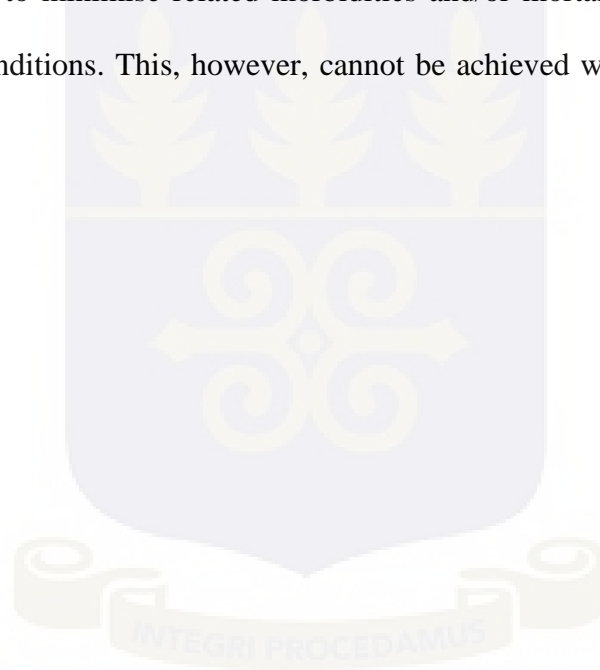
Although some metropolitan laws exist concerning the provision of basic water and sanitation facilities in households, these are not strictly adhered to. It must be enforced. The current development agenda, particularly in resource-poor communities must employ expert knowledge to translate or interpret data, graphs, statistical indices and models into forms that are easily comprehended and appreciated by the populace (Burch et al., 2013). Further studies could explore the reasons household heads rank their household as low, medium, high or very high respect to their vulnerability.

The fact that the more vulnerable a household is (in terms of their sociodemographic profile), the less likely they are to relocate suggests the presence of some “trapped” households. These households simply lack the resources or capacity to move in the face of flooding. Consequently, it may be necessary to relocate these households in a planned manner, spear-headed by the government or development agencies.

Infrastructural development

Improved planning of urban systems, particularly infrastructure development can help reduce the vulnerability and increase the resilience of resource-poor households to floods. This study revealed a very poor water and sanitation situation in the study communities. Over three-quarters of the households investigated had no improved toilet facilities. The IPCC Fourth Assessment Report indicates that climate change will not only affect the water cycle, but also wastewater and sanitation utilities. This buttresses the need for urban planners to adapt infrastructure that can withstand events such as floods. Unimproved toilet facilities become an excellent recipe for outbreaks of diseases as wastewater easily seeps into or get mixed with drinking water sources. Interventions such as mounting a campaign for the use of improved toilet facilities in these localities will address some of these sanitation and health concerns.

While permanent measures are being pursued, setting up temporary water and improved toilet facilities, particularly during floods should be encouraged to avert the outbreak of diseases. Floods occur in these communities not solely because of the increase in precipitation, but also because of inadequate drainage systems. An improvement in the drainage system in the form of creating more gutters within the communities for the efficient discharge of water from the communities into bigger drainage system will bring some relief. Existing drainage systems could also be maintained or repaired. The ultimate objective of any intervention to address the water and sanitation situation of these communities is to minimise related morbidities and/or mortalities resulting from poor environmental health conditions. This, however, cannot be achieved without the cooperation of the populace.



REFERENCES

- ADAMS, L. & WINAHYU, R. 2006. Learning from cash responses to the tsunami. Case Studies. *Humanitarian Policy Group, Overseas Development Institute, London.*
- ADDO, K. A., WALKDEN, M. & MILLS, J. P. T. 2008. Detection, measurement and prediction of shoreline recession in Accra, Ghana. *ISPRS Journal of Photogrammetry and Remote Sensing*, 63, 543-558.
- ADENIJI, G. & OGUNDIJI, B. Climate adaptation in Nigerian cities; Regularising informal and illegal settlements in Ibadan. Fifth Urban Res. Symp, 2009. 1-21.
- ADGER, W. N., ARNELL, N. W. & TOMPKINS, E. L. 2005. Successful adaptation to climate change across scales. *Global environmental change*, 15, 77-86.
- ADGER, W. N., HUQ, S., BROWN, K., CONWAY, D. & HULME, M. 2003. Adaptation to climate change in the developing world. *Progress in development studies*, 3, 179-195.
- ADLER, L. L. & GIELEN, U. P. 2003. *Migration: Immigration and emigration in international perspective*, Greenwood Publishing Group.
- ADONGO, P. B., KIRKWOOD, B. & KENDALL, C. 2005. How local community knowledge about malaria affects insecticide-treated net use in northern Ghana. *Tropical Medicine & International Health*, 10, 366-378.
- AHMED, S. 2015. Tackling poverty in the age of changing climate: The “most-likely” missing variable in climate adaptation in bangladesh. *Poverty Brief*. CROP.
- ALFA, B., HASHOLT, B., JØRGENSEN, N. & BANOENG-YAKUBO, B. 2011. Rainfall and water resources of a coastal basin of Ghana. *Journal of Hydrologic Engineering*, 16, 316-323.
- ALI, B., NYANDIGA, C., WANJIRU, L., MOGELGAARD, K. & SIDI, A. 2014. 14 Gender in scaling up community-based adaptation to climate change. *Community-Based Adaptation to Climate Change: Scaling it Up*, 226.
- AMOAKO, C. & FRIMPONG BOAMAH, E. 2015. The three-dimensional causes of flooding in Accra, Ghana. *International Journal of Urban Sustainable Development*, 7, 109-129.
- ANAND, S. 1994. Human development index: methodology and measurement. Human Development Report Office (HDRO), United Nations Development Programme (UNDP).
- ANTWI-AGYEI, P., FRASER, E. D. G., DOUGILL, A. J., STRINGER, L. C. & SIMELTON, E. 2012. Mapping the vulnerability of crop production to drought in Ghana using rainfall, yield and socioeconomic data. *Applied Geography*, 32, 324-334.

- APPEANING ADDO, K., LARBI, L., AMISIGO, B. & OFORI-DANSON, P. K. 2011. Impacts of Coastal Inundation Due to Climate Change in a CLUSTER of Urban Coastal Communities in Ghana, West Africa. *Remote Sensing*, 3, 2029.
- ARMAH, F. A., YAWSON, D. O., YENGOH, G. T., ODOI, J. O. & AFRIFA, E. K. 2010. Impact of floods on livelihoods and vulnerability of natural resource dependent communities in Northern Ghana. *Water*, 2, 120-139.
- ARORA-JONSSON, S. 2011. Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change*, 21, 744-751.
- ASENSO-OKYERE, W., TWUM-BAAH, K., KASANGA, A., ANUM, J. & PÖRTNER, C. 2000. Ghana living standards survey. *Report of the Fourth Round (GLSS 4)*. Ghana Statistical Service, Accra, Ghana.
- BAAN, P. J. & KLIJN, F. 2004. Flood risk perception and implications for flood risk management in the Netherlands. *International Journal of River Basin Management*, 2, 113-122.
- BARTRAM, J. 2009. *Water safety plan manual: step-by-step risk management for drinking-water suppliers*, World Health Organization.
- BARTRAM, J. & CAIRNCROSS, S. 2010. Hygiene, sanitation, and water: forgotten foundations of health. *PLoS Med*, 7, e1000367.
- BATES, B., KUNDZEWICZ, Z. W., WU, S. & PALUTIKOF, J. 2008. *Climate change and water: Technical paper vi*, Intergovernmental Panel on Climate Change (IPCC).
- BEAUMIER, M. C. & FORD, J. D. 2010. Food insecurity among Inuit women exacerbated by socioeconomic stresses and climate change. *Canadian Journal of Public Health/Revue Canadienne de Sante'e Publique*, 196-201.
- BERN, C., SNIEZEK, J., MATHBOR, G., SIDDIQI, M. S., RONSMANS, C., CHOWDHURY, A., CHAUDHURY, A., ISLAM, K., BENNISH, M. & NOJI, E. 1993. Risk factors for mortality in the Bangladesh cyclone of 1991. *Bulletin of the World Health Organization*, 71, 73.
- BERNARD, H. R. & BERNARD, H. R. 2012. *Social research methods: Qualitative and quantitative approaches*, Sage.
- BLACK, R., ARNELL, N. W., ADGER, W. N., THOMAS, D. & GEDDES, A. 2013. Migration, immobility and displacement outcomes following extreme events. *Environmental Science & Policy*, 27, S32-S43.
- BOATENG, I., BRAY, M. & HOOKE, J. 2012. Estimating the fluvial sediment input to the coastal sediment budget: a case study of Ghana. *Geomorphology*, 138, 100-110.

- BOLBOACA, S.-D. & JÄNTSCHI, L. 2006. Pearson versus Spearman, Kendall's tau correlation analysis on structure-activity relationships of biologic active compounds. *Leonardo Journal of Sciences*, 5, 179-200.
- BOTZEN, W., AERTS, J. & VAN DEN BERGH, J. 2009. Dependence of flood risk perceptions on socioeconomic and objective risk factors. *Water Resources Research*, 45.
- BRADFORD, R., O'SULLIVAN, J., VAN DER CRAATS, I., KRYWKOW, J., ROTKO, P., AALTONEN, J., BONAIUTO, M., DOMINICIS, S. D., WAYLEN, K. & SCHELFAUT, K. 2012. Risk perception—issues for flood management in Europe. *Natural hazards and earth system sciences*, 12, 2299-2309.
- BROOKS, N., ADGER, W. N. & KELLY, P. M. 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global environmental change*, 15, 151-163.
- BROUWER, R., AKTER, S., BRANDER, L. & HAQUE, E. 2007. Socioeconomic vulnerability and adaptation to environmental risk: a case study of climate change and flooding in Bangladesh. *Risk analysis*, 27, 313-326.
- BUAH, F. K. 1998. *A history of Ghana*, Macmillan.
- BURCH, S., SHEPPARD, S., POND, E. & SCHROTH, O. 2013. Climate change visioning—effective processes for advancing the policy and practice of local adaptation. *Successful Adaptation: Linking Science and Practice in Managing Climate Change Impacts*. London: Routledge, 270-287.
- BURTON, I., DIRINGER, E. & SMITH, J. 2006. *Adaptation to climate change: international policy options*, Pew Center on Global Climate Change Arlington, VA.
- BUTZER, K. W. 1989. Cultural ecology. *Geography in America*, 192-208.
- CAMPBELL, J. R., GOLDSMITH, M. & KOSHY, K. 2007. *Community relocation as an option for adaptation to the effects of climate change and climate variability in Pacific Island Countries (PICs)*, Asia-Pacific Network for Global Change Research.
- CAN, N. D., TU, V. H. & HOANH, C. T. 2013. Application of livelihood vulnerability index to assess risks from flood vulnerability and climate variability-A case study in the Mekong Delta of Vietnam. *Journal of Environmental Science and Engineering*. A, 2, 476.
- CARDONA, O.-D., VAN AALST, M. K., BIRKMANN, J., FORDHAM, M., MCGREGOR, G., PEREZ, R., PULWARTY, R. S., SCHIPPER, E. L. F. & SINH, B. T. 2012. Determinants of risk: exposure and vulnerability. *Managing the risks of extreme events and disasters to advance climate change adaptation*, 65-108.

- CASSELS, S., JENNESS, S. M., BINEY, A. A., AMPOFO, W. K. & DODOO, F. N.-A. 2014. Migration, sexual networks, and HIV in Agbogbloshie, Ghana. *Demographic research*, 31, 861.
- CEPAL 2002. Socio-demographic vulnerability: Old and new risks for communities, households and individuals. Brasilia, Brazil: Economic Commission for Latin America and the Caribbean, ECLAC.
- CHAMBERS, R. & CONWAY, G. 1992. *Sustainable rural livelihoods: practical concepts for the 21st century*, Institute of Development Studies (UK).
- CHOMSRI, J. & SHERER, P. 2013. Social vulnerability and suffering of flood-affected people: case study of 2011 mega flood in Thailand. *Kasetsart J. Soc. Sci.*, 491-499.
- CIAMPI, M. C., GELL, F., LASAP, L. & TURVILL, E. 2013. Gender and Disaster Risk Reduction.
- CODJOE, S. N. A. & AFUDUO, S. 2015. Geophysical, socio-demographic characteristics and perception of flood vulnerability in Accra, Ghana. *Natural Hazards*, 77, 787-804.
- CODJOE, S. N. A., ATIDOH, L. K. & BURKETT, V. 2012. Gender and occupational perspectives on adaptation to climate extremes in the Afram Plains of Ghana. *Climatic Change*, 110, 431-454.
- CODJOE, S. N. A., OKUTU, D. & ABU, M. 2016. Urban Household Characteristics and Dietary Diversity: An Analysis of Food Security in Accra, Ghana. *Food and nutrition bulletin*, 37, 202-218.
- CODJOE, S. N. A., OWUSU, G. & BURKETT, V. 2014. Perception, experience, and indigenous knowledge of climate change and variability: the case of Accra, a sub-Saharan African city. *Regional environmental change*, 14, 369-383.
- COLES, J. B., ZHUANG, J. & YATES, J. 2012. Case study in disaster relief: A descriptive analysis of agency partnerships in the aftermath of the January 12th, 2010 Haitian earthquake. *Socio-Economic Planning Sciences*, 46, 67-77.
- COOKE, M., MITROU, F., LAWRENCE, D., GUIMOND, E. & BEAVON, D. 2007. Indigenous well-being in four countries: an application of the UNDP's human development index to Indigenous peoples in Australia, Canada, New Zealand, and the United States. *BMC international health and human rights*, 7, 1.
- CROOKS, S. 2004. The effect of sea-level rise on coastal geomorphology. *Ibis*, 146, 18-20.
- CUTTER, S., BORUFF, B. J. & SHIRLEY, W. L. 2006. Social vulnerability to environmental hazards. *Hazards, Vulnerability, and Environmental Justice*, 115-132.
- CUTTER, S. L., EMRICH, C. T., WEBB, J. J. & MORATH, D. 2009. Social vulnerability to climate variability hazards: A review of the literature. *Final Report to Oxfam America*, 5.
- DANSO, S. Y. & ADDO, I. Y. 2016. Coping strategies of households affected by flooding: A case study of Sekondi-Takoradi Metropolis in Ghana. *Urban Water Journal*, 1-7.

- DENEVAN, W. M. 1983. Adaptation, variation, and cultural geography*. *The Professional Geographer*, 35, 399-407.
- DERESSA, T. T., HASSAN, R. M. & RINGLER, C. 2009. *Assessing household vulnerability to climate change*, Intl Food Policy Res Inst.
- DEWEY III, D. 1988. When a congregation cares: Organizing ministry to the bereaved. *Death studies*, 12, 123-135.
- DING, G., GAO, L., LI, X., ZHOU, M., LIU, Q., REN, H. & JIANG, B. 2014. A mixed method to evaluate burden of malaria due to flooding and waterlogging in Mengcheng county, China: A case study. *PloS one*, 9, e97520.
- DING, G., ZHANG, Y., GAO, L., MA, W., LI, X., LIU, J., LIU, Q. & JIANG, B. 2013. Quantitative analysis of burden of infectious diarrhea associated with floods in northwest of Anhui Province, China: A mixed method evaluation. *PloS one*, 8, e65112.
- DOW, K., BERKHOUT, F. & PRESTON, B. L. 2013. Limits to adaptation to climate change: a risk approach. *Current Opinion in Environmental Sustainability*, 5, 384-391.
- DU, W., FITZGERALD, G. J., CLARK, M. & HOU, X.-Y. 2010. Health impacts of floods. *Prehospital and disaster medicine*, 25, 265-272.
- DZIAŁEK, J., BIERNACKI, W. & BOKWA, A. 2013. Challenges to social capacity building in flood-affected areas of southern Poland. *Natural Hazards and Earth System Sciences*, 13, 2555-2566.
- EBI, K. L., KOVATS, R. S. & MENNE, B. 2006. An approach for assessing human health vulnerability and public health interventions to adapt to climate change. *Environmental health perspectives*, 1930-1934.
- EPA, 2003, *Information for Africa climate technology transfer (IACTT)*, viewed 10 June 2012, from http://www.epa.gov.gh/iACTT/Ghana_VA%20Coastal%20Zone%20.pdf
- ETWIRE, P. M., AL-HASSAN, R. M., KUWORNU, J. K. & OSEI-OWUSU, Y. 2013. Application of livelihood vulnerability index in assessing vulnerability to climate change and variability in Northern Ghana. *Journal of Environment and Earth Science*, 3, 157-170.
- FEDOROFF, N., BATTISTI, D., BEACHY, R., COOPER, P., FISCHHOFF, D., HODGES, C., KNAUF, V., LOBELL, D., MAZUR, B. & MOLDEN, D. 2010. Radically rethinking agriculture for the 21st century. *Science (New York, NY)*, 327, 833.
- FERNANDEZ, M. A., BUCARAM, S. J. & RENTERIA, W. 2015. Assessing local vulnerability to climate change in Ecuador. *SpringerPlus*, 4, 1-20.

- FERROL-SCHULTE, D., WOLFF, M., FERSE, S. & GLASER, M. 2013. Sustainable Livelihoods Approach in tropical coastal and marine social–ecological systems: A review. *Marine policy*, 42, 253-258.
- FEW, R. 2003. Flooding, vulnerability and coping strategies: local responses to a global threat. *Progress in Development Studies*, 3, 43-58.
- FEW, R., BROWN, K. & TOMPKINS, E. L. 2006. Public participation and climate change adaptation. *Tyndall Centre for Climate Change Research Working Paper*, 95.
- FIELD, C., BARROS, V., MACH, K. & MASTRANDREA, M. 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Press Syndicate of the University of Cambridge, Cambridge, UK.
- FILATOVA, T. 2014. Market-based instruments for flood risk management: A review of theory, practice and perspectives for climate adaptation policy. *Environmental Science & Policy*, 37, 227-242.
- FILIBERTO, D., WETHINGTON, E., PILLEMER, K., WELLS, N., WYSOCKI, M. & PARISE, J. T. 2009. Older people and climate change: vulnerability and health effects. *Generations*, 33, 19-25.
- FISCHER, G., SHAH, M., TUBIELLO, F. N. & VAN VELHUIZEN, H. 2005. Socio-economic and climate change impacts on agriculture: an integrated assessment, 1990–2080. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 360, 2067-2083.
- FORD, J. D., BERRANG-FORD, L., LESNIKOWSKI, A., BARRERA, M. & HEYMANN, S. J. 2013. How to track adaptation to climate change: a typology of approaches for national-level application. *Ecology and Society*, 18, 40.
- FOSU-MENSAH, B. Y., VLEK, P. L. G. & MACCARTHY, D. S. 2012. Farmers' perception and adaptation to climate change: a case study of Sekyedumase district in Ghana. *Environment, Development and Sustainability*, 14, 495-505.
- FÜSSEL, H.-M. 2007a. Adaptation planning for climate change: concepts, assessment approaches, and key lessons. *Sustainability science*, 2, 265-275.
- FÜSSEL, H.-M. 2007b. Vulnerability: a generally applicable conceptual framework for climate change research. *Global environmental change*, 17, 155-167.
- FÜSSEL, H. M. 2005. Vulnerability in climate change research: A comprehensive conceptual framework. *University of California International and Area Studies*.
- GERLITZ, J.-Y., APABLAZA, M., HOERMANN, B., HUNZAI, K. & BENNETT, L. 2015. A Multidimensional Poverty Measure for the Hindu Kush-Himalayas, Applied to Selected Districts in Nepal. *Mountain Research and Development*, 35, 278-288.

- GHIMIRE, Y. N., SHIVAKOTI, G. P. & PERRET, S. R. 2010. Household-level vulnerability to drought in hill agriculture of Nepal: implications for adaptation planning. *International Journal of Sustainable Development & World Ecology*, 17, 225-230.
- GIBSON, R. B. 2006. Sustainability assessment: basic components of a practical approach. *Impact Assessment and Project Appraisal*, 24, 170-182.
- GSS 2012. *Final report on population and housing census*. Accra, Sakoa Press Limited, Accra Ghana Statistical Service.
- HABLUETZEL, A., DIALLO, D., ESPOSITO, F., LAMIZANA, L., PAGNONL, F., LENGELER, C., TRAORE, C. & COUSENS, S. 1997. Do insecticide-treated curtains reduce all-cause child mortality in Burkina Faso? *Tropical Medicine & International Health*, 2, 855-862.
- HADDAD, Z. & PRATS, E. V. 2012. Mainstreaming gender in health adaptation to climate change programmes. *WHO training manual Gender mainstreaming for health managers: a practical approach*. Switzerland: World Health Organization.
- HAHN, M. B., RIEDERER, A. M. & FOSTER, S. O. 2009. The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change—A case study in Mozambique. *Global Environmental Change*, 19, 74-88.
- HARLEY, M., HORROCKS, L., HODGSON, N. & VAN MINNEN, J. 2008. Climate change vulnerability and adaptation indicators. *European Topic Centre on Air and Climate Change (ETC/ACC) Technical Paper 2008*, 9.
- HARRIS, C. R., JENKINS, M. & GLASER, D. 2006. Gender differences in risk assessment: why do women take fewer risks than men? *Judgment and Decision Making*, 1, 48.
- HENRY, R. & FAYORSEY, C. 2002. *Coping with pregnancy: experiences of adolescents in Ga Mashi* Accra.
- HIKICHI, H., SAWADA, Y., TSUBOYA, T., AIDA, J., KONDO, K., KOYAMA, S. & KAWACHI, I. 2017. Residential relocation and change in social capital: A natural experiment from the 2011 Great East Japan Earthquake and Tsunami. *Science advances*, 3, e1700426.
- HINKEL, J. 2011. “Indicators of vulnerability and adaptive capacity”: towards a clarification of the science–policy interface. *Global Environmental Change*, 21, 198-208.
- HOWARD, G. & BARTRAM, J. The resilience of water supply and sanitation in the face of climate change Technical report.
- HOWARD, G. & BARTRAM, J. 2010. Vision 2030: The resilience of water supply and sanitation in the face of climate change. *Ginebra, Organización Mundial de la Salud (OMS), [en línea] www.who.int/water_sanitation_health/vision_2030_9789241598422.pdf*.

- HUGO, G. 1996. Environmental concerns and international migration. *International migration review*, 105-131.
- HUNTER, L. M. 2005. Migration and environmental hazards. *Population and environment*, 26, 273-302.
- HURLBERT, J. S., BEGGS, J. J. & HAINES, V. A. 2001. Social networks and social capital in extreme environments. *Social capital: Theory and research*, 209-231.
- HYNDMAN, D. & HYNDMAN, D. 2016. *Natural hazards and disasters*, Cengage Learning.
- IBE, A. & QUELENNAC, R. 1989. Methodology for assessment and control of coastal erosion in west Africa and central Africa. UNEP Regional Sea Reports and Studies No. 107. Programme des Nations Unies pour l'environnement, New York, NY, E. *New York: United National Environmental Programme*.
- IPCC 2001. *Climate change 2001: impacts, adaptation, and vulnerability: contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.
- IPCC 2012a. Glossary of terms. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. In: FIELD, C. B., V. BARROS, T.F. STOCKER, D. QIN, D.J. DOKKEN, K.L. EBI, M.D. MASTRANDREA, K.J. MACH, G.-K. PLATTNER, S.K. ALLEN, M. TIGNOR, AND P.M. MIDGLE (ed.). Cambridge University Press, Cambridge, UK, and New York, NY, USA.
- IPCC 2012b. *Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change*, Cambridge University Press.
- IPCC 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, Intergovernmental Panel on Climate Change. Working Group II.
- JHA, A. K., BLOCH, R. & LAMOND, J. 2012. *Cities and flooding: a guide to integrated urban flood risk management for the 21st century*, World Bank Publications.
- JHA, A. K. & DUYNE, J. E. 2010. *Safer homes, stronger communities: a handbook for reconstructing after natural disasters*, World Bank Publications.
- KANKAM-YEBOAH, K., AMISIGO, B. & OBUOBI, E. 2011. Climate change impacts on water resources in Ghana. Ghana National Commission for UNESCO. Retrieved from <http://www.natcomreport.com/ghana/livre/climate-change.pdf>.
- KAPEPULA, K.-M., COLSON, G., SABRI, K. & THONART, P. 2007. A multiple criteria analysis for household solid waste management in the urban community of Dakar. *Waste Management*, 27, 1690-1705.
- KARLEY, N. K. 2009. Flooding and physical planning in urban areas in West Africa: situational analysis of Accra, Ghana. *Theoretical and Empirical Researches in Urban Management*, 4, 25-41.

- KASPERSON, R. E. & KASPERSON, J. X. 2001. *Climate change, vulnerability, and social justice*, Stockholm Environment Institute Stockholm.
- KATES, R. W., COLTEN, C. E., LASKA, S. & LEATHERMAN, S. P. 2006. Reconstruction of New Orleans after Hurricane Katrina: a research perspective. *Proceedings of the National Academy of Sciences*, 103, 14653-14660.
- KELLENS, W., ZAALBERG, R., NEUTENS, T., VANNEUVILLE, W. & DE MAEYER, P. 2011. An analysis of the public perception of flood risk on the Belgian coast. *Risk Analysis*, 31, 1055-1068.
- KELLY, P. M. & ADGER, W. N. 2000. Theory and practice in assessing vulnerability to climate change and Facilitating adaptation. *Climatic change*, 47, 325-352.
- KRANTZ, L. 2001. The sustainable livelihood approach to poverty reduction. *SIDA. Division for Policy and Socio-Economic Analysis*.
- KUSAKABE, K., SHRESTHA, R. & VEENA, N. 2015. *Gender and land tenure in the context of disaster in Asia*, Springer.
- KWAKU, X. S. & DUKE, O. 2007. Characterization and frequency analysis of one day annual maximum and two five consecutive days' maximum rainfall of Accra, Ghana. *ARPJ. Eng. Appl. Sci*, 2, 27-31.
- LAMICHHANE, K. 2010. Sustainable livelihood approach in assessment of vulnerability to the impacts of climate change: A study of Chhekampar VDC, Gorkha District of Nepal. *Project Work submitted to the Kathmandu University, Center For Development Studies, National College, Baluwatar*.
- LARSEN, D. A., HUTCHINSON, P., BENNETT, A., YUKICH, J., ANGLEWICZ, P., KEATING, J. & EISELE, T. P. 2014. Community coverage with insecticide-treated mosquito nets and observed associations with all-cause child mortality and malaria parasite infections. *The American journal of tropical medicine and hygiene*, 91, 950-958.
- LEARY, N. & KULKARNI, J. 2007. Climate change vulnerability and adaptation in developing country regions. *Draft Final Report of the AIACC Project, UNEP, Nairobi*.
- LINDLEY, S., O'NEILL, J., KANDEH, J., LAWSON, N., CHRISTIAN, R. & O'NEILL, M. 2011. Climate change, justice and vulnerability. *Joseph Rowntree Foundation, York*.
- LIST, C. 2003. Are interpersonal comparisons of utility indeterminate? *Erkenntnis*, 58, 229-260.
- LIVERMAN, D. M. 1990. Vulnerability to global environmental change. *Understanding global environmental change: The contributions of risk analysis and management*, 27-44.
- LOLIG, V., DONKOH, S. A., OBENG, F. K., ANSAH, I. G. K., JASAW, G. S., KUSAKARI, Y., ASUBONTENG, K. O., GANDAA, B. & DAYOUR, F. 2014. Households' Coping Strategies in Drought-and Flood-Prone Communities in Northern Ghana. *Journal of Disaster Research Vol*, 9.

- LOVEKAMP, W. E. 2006. *Gender, Race/ethnicity and Social Class Differences in Disaster Preparedness, Risk and Recovery in Three Earthquake-stricken Communities*, ProQuest.
- LUTZ, W., STRIESSNIG, E. & PATT, A. G. 2013. Effects of educational attainment on climate risk vulnerability.
- MADU, I. 2012. Partial vulnerability of rural households to climate change in Nigeria: Implication for internal security. WP-2; May 2012. Univ. of Texas, USA: The Robert S. *Strauss Center for Int. Security and Law*. *In article*.
- MANANGAN, A. P., UEJIO, C. K., SAHA, S., SCHRAMM, P. J., MARINUCCI, G. D., HESS, J. J. & LUBER, G. 2008. Assessing Health Vulnerability to Climate Change. *Marmot, M., Friel, S., Bell, R., Houweling, TA, & Taylor, S*, 1661-1669.
- MARSHALL, N., STOKES, C., WEBB, N., MARSHALL, P. & LANKESTER, A. 2014. Social vulnerability to climate change in primary producers: A typology approach. *Agriculture, Ecosystems & Environment*, 186, 86-93.
- MASANJALA, W. 2007. The poverty-HIV/AIDS nexus in Africa: a livelihood approach. *Social Science & Medicine*, 64, 1032-1041.
- MCCARTHY, J. J. 2001. *Climate change 2001: impacts, adaptation, and vulnerability: contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.
- MCGEEHIN, M. A. & MIRABELLI, M. 2001. The potential impacts of climate variability and change on temperature-related morbidity and mortality in the United States. *Environmental health perspectives*, 109, 185.
- MCIVER, L., KIM, R., WOODWARD, A., HALES, S., SPICKETT, J., KATSCHERIAN, D., HASHIZUME, M., HONDA, Y., KIM, H. & IDDINGS, S. 2015. Health Impacts of Climate Change in Pacific Island Countries: A Regional Assessment of Vulnerabilities and Adaptation Priorities. *Environ Health Perspect*.
- MCIVOR, D. & PATON, D. 2007. Preparing for natural hazards: normative and attitudinal influences. *Disaster Prevention and Management: An International Journal*, 16, 79-88.
- MCLEMAN, R. & SMIT, B. 2006. Migration as an adaptation to climate change. *Climatic change*, 76, 31-53.
- MEARNS, R. & NORTON, A. 2010. *Social dimensions of climate change: equity and vulnerability in a warming world*, World Bank Publications.
- MENDELSON, R., DINAR, A. & WILLIAMS, L. 2006. The distributional impact of climate change on rich and poor countries. *Environment and Development Economics*, 11, 159-178.

- MENDELSON, R., EMANUEL, K., CHONABAYASHI, S. & BAKKENSEN, L. 2012. The impact of climate change on global tropical cyclone damage. *Nature Climate Change*, 2, 205-209.
- MORTREUX, C. & BARNETT, J. 2009. Climate change, migration and adaptation in Funafuti, Tuvalu. *Global Environmental Change*, 19, 105-112.
- MULLER, M. 2007. Adapting to climate change water management for urban resilience. *Environment and Urbanization*, 19, 99-113.
- MUMUNI, A. 2013. *Flooding and Diarrhoeal Disease Incidence in Urban Poor Communities in Accra, Ghana. Investigating the Effects of Risk Perception Measures*. University of Ghana.
- MUTTARAK, R. & LUTZ, W. 2014a. Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change. *Ecology and society*, 19, 42.
- MUTTARAK, R. & LUTZ, W. 2014b. Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change? *Ecology and society*, 19, 42.
- MYERS, N. 2002. Environmental refugees: a growing phenomenon of the 21st century. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 357, 609-613.
- NAWROTZKI, R. J. & DEWAARD, J. 2017. Putting trapped populations into place: climate change and inter-district migration flows in Zambia. *Regional Environmental Change*, 1-14.
- NELSON, R., KOKIC, P., CRIMP, S., MARTIN, P., MEINKE, H., HOWDEN, S., DE VOIL, P. & NIDUMOLU, U. 2010. The vulnerability of Australian rural communities to climate variability and change: Part II—Integrating impacts with adaptive capacity. *Environmental Science & Policy*, 13, 18-27.
- NEWSON, R. 2002. Parameters behind "nonparametric" statistics: Kendall's tau, Somers' D and median differences.
- NG'ANG'A, S., DIARRA, L., NOTENBAERT, A. & HERRERO, M. 2013. Coping strategies and vulnerability to climate change of households in Mali.
- NICHOLL, J., WEST, J., GOODACRE, S. & TURNER, J. 2007. The relationship between distance to hospital and patient mortality in emergencies: an observational study. *Emergency Medicine Journal*, 24, 665-668.
- NKONDZE, M. S., MASUKU, M. B. & MANYATSI, A. 2013. Factors Affecting Households Vulnerability to Climate Change in Swaziland: A Case of Mpolonjeni Area Development Programme (ADP). *Journal of Agricultural Science*, 5, 108.
- NKRUMAH, F., KLUTSE, N. A. B., ADUKPO, D. C., OWUSU, K., QUAGRAINE, K. A., OWUSU, A. & GUTOWSKI, W. 2014. Rainfall variability over Ghana: model versus rain gauge observation. *International Journal of Geosciences*, 5, 673.

- NOTENBAERT, A., KARANJA, S. N., HERRERO, M., FELISBERTO, M. & MOYO, S. 2013. Derivation of a household-level vulnerability index for empirically testing measures of adaptive capacity and vulnerability. *Regional Environmental Change*, 13, 459-470.
- NYARKO, S. H. & COBBLAH, A. 2014. Sociodemographic determinants of Malaria among under-five children in Ghana. *Malaria research and treatment*, 2014.
- O'BRIEN, K., ERIKSEN, S., NYGAARD, L. P. & SCHJOLDEN, A. 2007. Why different interpretations of vulnerability matter in climate change discourses. *Climate policy*, 7, 73-88.
- O'BRIEN, K., ERIKSEN, S. E., SCHJOLDEN, A. & NYGAARD, L. P. 2004. What's in a word? Conflicting interpretations of vulnerability in climate change research. *CICERO Working Paper*.
- O'BRIEN, K. L. 2009. Do values subjectively define the limits to climate change adaptation? *Adapting to climate change: Thresholds, values, governance*, 164.
- OKOT-OKUMU, J. & NYENJE, R. 2011. Municipal solid waste management under decentralisation in Uganda. *Habitat International*, 35, 537-543.
- OKWARAJI, Y. B., COUSENS, S., BERHANE, Y., MULHOLLAND, K. & EDMOND, K. 2012. Effect of geographical access to health facilities on child mortality in rural Ethiopia: a community based cross sectional study. *PLoS One*, 7, e33564.
- OPIYO, F. E., WASONGA, O. V. & NYANGITO, M. M. 2014. Measuring household vulnerability to climate-induced stresses in pastoral rangelands of Kenya: Implications for resilience programming. *Pastoralism*, 4, 1-15.
- OTENG-ABABIO, M., MELARA ARGUELLO, J. E. & GABBAY, O. 2013. Solid waste management in African cities: Sorting the facts from the fads in Accra, Ghana. *Habitat International*, 39, 96-104.
- OTHNIEL, Y., EBERHARD, W. & ANDREAS, N. 2013. The Role of Social Capital in Post-Flood Response and Recovery among Downstream Communities of the Ba River, Western Viti Levu, Fiji Islands. *Risks and Conflicts: Local Responses to Natural Disasters*. Emerald Group Publishing Limited.
- OWUSU, K. & WAYLEN, P. 2009. Trends in spatio-temporal variability in annual rainfall in Ghana (1951-2000). *Weather*, 64, 115-120.
- PACHAURI, R. K., ALLEN, M., BARROS, V., BROOME, J., CRAMER, W., CHRIST, R., CHURCH, J., CLARKE, L., DAHE, Q. & DASGUPTA, P. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
- PARRY, M., CANZIANI, O., PALUTIKOF, J., VAN DER LINDEN, P. & HANSON, C. 2007. Contribution of working group II to the fourth assessment report of the intergovernmental panel

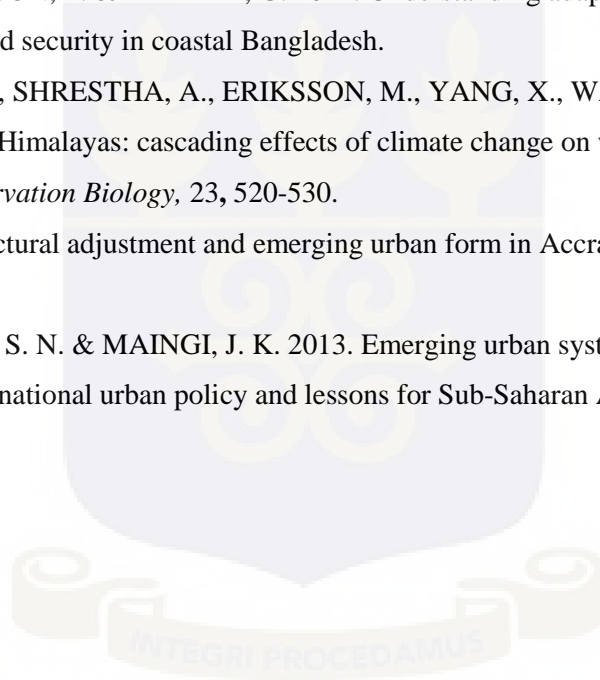
- on climate change, 2007. *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability*.
- PARVIN, G. A., FUJITA, K., MATSUYAMA, A., SHAW, R. & SAKAMOTO, M. 2015. Climate Change, Flood, Food Security and Human Health: Cross-Cutting Issues in Bangladesh. *Food Security and Risk Reduction in Bangladesh*. Springer.
- PELLING, M. 2012. *The vulnerability of cities: natural disasters and social resilience*, Earthscan.
- PERRY, J. 2015. Climate change adaptation in the world's best places: A wicked problem in need of immediate attention. *Landscape and Urban Planning*, 133, 1-11.
- PIRARD, P., VANDENTORREN, S., PASCAL, M., LAAIDI, K., LE TERTRE, A., CASSADOU, S. & LEDRANS, M. 2005. Summary of the mortality impact assessment of the 2003 heat wave in France. *Euro surveillance: bulletin Europeen sur les maladies transmissibles= European communicable disease bulletin*, 10, 153-156.
- PIYA, L., MAHARJAN, K. L. & JOSHI, N. P. Vulnerability of rural households to climate change and extremes: Analysis of Chepang households in the Mid-Hills of Nepal. Selected paper prepared for presentation at the International Association of Agricultural Economics (IAAE) Triennial Conference, Foz do Iguacu, Brazil, 2012. 18-24.
- PODEWILS, L. J., MINTZ, E. D., NATARO, J. P. & PARASHAR, U. D. Acute, infectious diarrhea among children in developing countries. *Seminars in pediatric infectious diseases*, 2004. WB Saunders, 155-168.
- POOYAN, Z. 2004. A study on community disaster response: A way toward vulnerability reduction.
- PORTIER, C. J., TART, K. T., CARTER, S. R., DILWORTH, C. H., GRAMBSCH, A. E., GOHLKE, J., HESS, J., HOWARD, S., LUBER, G. & LUTZ, J. 2013. A human health perspective on climate change: a report outlining the research needs on the human health effects of climate change. *Journal of Current Issues in Globalization*, 6, 621.
- PUTNAM, R. D. 1995. Tuning in, tuning out: The strange disappearance of social capital in America. *PS: Political science & politics*, 28, 664-683.
- RAHMAN, S. & RAHMAN, M. A. 2015. Climate extremes and challenges to infrastructure development in coastal cities in Bangladesh. *Weather and Climate Extremes*, 7, 96-108.
- RAIN, D., ENGSTROM, R., LUDLOW, C. & ANTOS, S. 2011a. Accra Ghana: A City Vulnerable to Flooding and Drought-Induced Migration. *UN-Habitat (Ed.), Background paper for*.
- RAIN, D., ENGSTROM, R., LUDLOW, C. & ANTOS, S. 2011b. Accra Ghana: A city vulnerable to flooding and drought-induced migration. *Case study prepared for cities and climate Change: Global Report on Human Settlements*, 2011, 1-21.

- RAJARAM, R. 2009. Female-headed households and poverty: evidence from the National Family Health Survey. *University of Georgia, USA*, 132-137.
- REDUCTION, I. S. F. D. 2004. *Living with risk: a global review of disaster reduction initiatives*, UN.
- RINNE, J., LYYTIMÄKI, J. & KAUTTO, P. 2013. From sustainability to well-being: Lessons learned from the use of sustainable development indicators at national and EU level. *Ecological indicators*, 35, 35-42.
- ROEHR, U. 2007. Gender, climate change and adaptation: Introduction to the gender dimensions. *Background Paper prepared for the Both Ends Briefing Paper Adapting to climate change: How local experiences can shape the debate*.
- RUTH, M. 2009. *Distributional impacts of climate change and disasters: Concepts and cases*, Edward Elgar Publishing.
- SAGALA, S. A. H. 2006. Analysis of flood physical vulnerability in residential areas. *Case study: Naga City, The Philippines, ITC*.
- SALIK, K. M., JAHANGIR, S. & UL HASSON, S. 2015. Climate change vulnerability and adaptation options for the coastal communities of Pakistan. *Ocean & Coastal Management*, 112, 61-73.
- SATO, M., NAKAMURA, Y., ATOGAMI, F., HORIGUCHI, R., TAMAKI, R., YOSHIZAWA, T. & OSHITANI, H. 2015. Immediate Needs and Concerns among Pregnant Women During and after Typhoon Haiyan (Yolanda). *PLoS currents*, 8.
- SCHANZE, J., ZEMAN, E. & MARSALEK, J. 2007. *Flood risk management: hazards, vulnerability and mitigation measures*, Springer Science & Business Media.
- SCHMIDHUBER, J. & TUBIELLO, F. N. 2007. Global food security under climate change. *Proceedings of the National Academy of Sciences*, 104, 19703-19708.
- SEM, G. Vulnerability and Adaptation to Climate Change in Small Island Developing States. UNFCC expert meeting on adaptation for small island developing states: Part II, Cook Islands, 2007.
- SHAH, K. U., DULAL, H. B., JOHNSON, C. & BAPTISTE, A. 2013. Understanding livelihood vulnerability to climate change: Applying the livelihood vulnerability index in Trinidad and Tobago. *Geoforum*, 47, 125-137.
- SHAKEELA, A. & BECKEN, S. 2013. Perceptions of climate change vulnerability and risks. *CAUTHE 2013: Tourism and Global Change: On the Edge of Something Big*, 729.
- SHAW, R., MALLICK, F. & ISLAM, A. 2013. *Climate change adaptation actions in Bangladesh*, Springer.
- SIEGRIST, M. & GUTSCHER, H. 2008. Natural hazards and motivation for mitigation behavior: People cannot predict the affect evoked by a severe flood. *Risk Analysis*, 28, 771-778.

- SMIT, B., BURTON, I., KLEIN, R. J. & WANDEL, J. 2000. An anatomy of adaptation to climate change and variability. *Climatic change*, 45, 223-251.
- SMIT, B. & PILIFOSOVA, O. 2003. Adaptation to climate change in the context of sustainable development and equity. *Sustainable Development*, 8, 9.
- SMIT, B. & WANDEL, J. 2006. Adaptation, adaptive capacity and vulnerability. *Global environmental change*, 16, 282-292.
- SMITHERS, J. & SMIT, B. 2009. Human adaptation to climatic variability and change. *Global environmental change*, 7, 129-146.
- SONGSORE, J., NABILA, J., YANGYUORU, Y., AVLE, S., BOSQUE-HAMILTON, E., AMPONSAH, P. E., ALHASSAN, O. & SATTERTHWAITE, D. 2009. *Environmental health watch and disaster monitoring in the Greater Accra Metropolitan Area (GAMA), 2005*, Ghana Universities Press Accra.
- STEEG, J., HERRERO, M. & NOTENBAERT, A. 2013. *Supporting the vulnerable: Increasing adaptive capacities of agropastoralists to climate change in West and southern Africa using a transdisciplinary research approach*, ILRI (aka ILCA and ILRAD).
- STOCKER, T. 2014. *Climate change 2013: the physical science basis: Working Group I contribution to the Fifth assessment report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.
- TERPSTRA, T. & LINDELL, M. K. 2013. Citizens' perceptions of flood hazard adjustments an application of the protective action decision model. *Environment and Behavior*, 45, 993-1018.
- THOMAS, R. 2008. Opportunities to reduce the vulnerability of dryland farmers in Central and West Asia and North Africa to climate change. *Agriculture, Ecosystems & Environment*, 126, 36-45.
- TOMPKINS, E. L., NICHOLSON-COLE, S. A., BOYD, E., HURLSTON, L., BROOKS HODGE, G., CLARKE, J., TROTZ, N., GRAY, G. & VARLACK, L. 2005. Surviving climate change in small islands. A guidebook.
- TORTI, J. 2012. Floods in Southeast Asia: A health priority. *Journal of Global Health*, 2, 020304.
- TSE, C.-W., WEI, J. & WANG, Y. 2013. Social capital and disaster recovery: Evidence from Sichuan earthquake in 2008. Available at SSRN 2440405.
- TWUMASI, Y. & ASOMANI-BOATENG, R. Mapping seasonal hazards for flood management in Accra, Ghana using GIS. Geoscience and Remote Sensing Symposium, 2002. IGARSS'02. 2002 IEEE International, 2002. IEEE, 2874-2876.
- UN, C., ASIAN DISASTER REDUCTION 2004. Living with risk. A global review of disaster reduction initiatives. Preliminary version. United Nations.

- United Nations (1992) United Nations Framework Convention on Climate Change.
FCCC/INFORMAL/84, GE.05-62220 (E) 200705
- UNFCCC 1992. Framework convention on climate change. *International Legal Materials*, 31, 849-873.
- UNFCCC 2005. Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change. *Final draft report*.
- UZZELL, D. L. 2000. The psycho-spatial dimension of global environmental problems. *Journal of environmental psychology*, 20, 307-318.
- VAN PRAAG, B. & KAPTEYN, A. 1973. Further evidence on the individual welfare function of income: An empirical investigation in The Netherlands. *European Economic Review*, 4, 33-62.
- VAN PRAAG, B. M. 1968. *Individual welfare functions and consumer behavior: A theory of rational irrationality*, North-Holland Pub. Co.
- VAN PRAAG, B. M. & FERRER-I-CARBONELL, A. 2008. *Happiness quantified: A satisfaction calculus approach*, Oxford University Press.
- VINCENT, K. 2004. Creating an index of social vulnerability to climate change for Africa. *Tyndall Center for Climate Change Research. Working Paper*, 56, 41.
- WALLS, C. T. & ZARIT, S. H. 1991. Informal support from black churches and the well-being of elderly blacks. *The Gerontologist*, 31, 490-495.
- WAMSLER, C. 2011. Climate change, adaptation and formal education: The role of schooling for increasing societies' adaptive capacities.
- WAMSLER, C. & BRINK, E. 2014. Moving beyond short-term coping and adaptation. *Environment and Urbanization*, 0956247813516061.
- WATER, U. 2009. The United Nations World Water Development Report 3—Water in a Changing World. UNESCO Publishing/Earthscan.
- WATSON, R. T., ZINYOWERA, M. C. & MOSS, R. H. 1998. *The regional impacts of climate change: an assessment of vulnerability*, Cambridge University Press.
- WATSON, R. T., ZINYOWERA, M. C., MOSS, R. H. & DOKKEN, D. J. 1996. Climate change 1995. Impacts, adaptations and mitigation of climate change: scientific-technical analyses.
- WATTS, M. J. & BOHLE, H. G. 1993. The space of vulnerability: the causal structure of hunger and famine. *Progress in human geography*, 17, 43-67.
- WESTERHOFF, L. & SMIT, B. 2008. The rains are disappointing us: dynamic vulnerability and adaptation to multiple stressors in the Afram Plains, Ghana. *Mitigation and Adaptation Strategies for Global Change*, 14, 317-337.

- WHO 2014a. Accelerating nutrition improvements (ANI): mapping of stakeholders and nutrition actions in three scaling-up countries in sub-Saharan Africa: report of a meeting, 27–28 February 2014, Addis Ababa, Ethiopia.
- WHO 2014b. World Malaria Report, 2012. Geneva: WHO, 2012. See http://www.who.int/malaria/publications/world_malaria_report_2013/wmr2013_country_profiles.pdf.
- WINTERHALDER, B. 1980. Environmental analysis in human evolution and adaptation research. *Human Ecology*, 8, 135-170.
- WOLF, J. & MOSER, S. C. 2011. Individual understandings, perceptions, and engagement with climate change: insights from in-depth studies across the world. *Wiley Interdisciplinary Reviews: Climate Change*, 2, 547-569.
- WRIGHT, H., KRISTJANSON, P. & BHATTA, G. 2012. Understanding adaptive capacity: Sustainable livelihoods and food security in coastal Bangladesh.
- XU, J., GRUMBINE, R. E., SHRESTHA, A., ERIKSSON, M., YANG, X., WANG, Y. & WILKES, A. 2009. The melting Himalayas: cascading effects of climate change on water, biodiversity, and livelihoods. *Conservation Biology*, 23, 520-530.
- YEBOAH, I. E. 2000. Structural adjustment and emerging urban form in Accra, Ghana. *Africa Today*, 47, 60-89.
- YEBOAH, I. E., CODJOE, S. N. & MAINGI, J. K. 2013. Emerging urban system demographic trends: informing Ghana's national urban policy and lessons for Sub-Saharan Africa. *Africa Today*, 60, 98-124.



HOUSEHOLD SCHEDULE

I would like some information about the people who usually live in your household or who are staying with you now.										
LINE NO.	USUAL RESIDENTS AND VISITORS	RELATIONSHIP TO HEAD OF HH	SEX	RESIDENCE			AGE	ELIGIBILITY		
	Please give me the names of the persons who usually live in your household and guests of the household who stayed here last night, starting with the head of the household.	What is the relationship of (NAME) to the head of the household?*	Is (NAME) male or female?	Does (NAME) usually live here? (6months or more)	Did (NAME) sleep here last night?	Why did (NAME) not sleep here last night? **	How old is (NAME)?	CIRCLE LINE NUMBER OF ALL CHILDREN UNDER AGE 5	CIRCLE LINE NUMBER OF ALL WOMEN AGE 15-49***	CIRCLE LINE NUMBER OF ALL MEN AGE 15-59***
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
01		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	01	01	01
02		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	02	02	02
03		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	03	03	03
04		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	04	04	04
05		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	05	05	05
06		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	06	06	06
07		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	07	07	07
08		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	08	08	08
		<input type="text"/>	1 2	1 2	1 2	<input type="text"/>	<input type="text"/>	09	09	09
10		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	10	10	10
11		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	11	11	11
12		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	12	12	12
13		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	13	13	13
14		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	14	14	14
15		<input type="text"/>	M F 1 2	YES NO 1 2	YES NO 1 2	<input type="text"/>	IN YEARS <input type="text"/>	15	15	15
TICK HERE IF CONTINUATION SHEET USED			NUMBER OF ELIGIBLE WOMEN			NUMBER OF ELIGIBLE MEN				
* CODES FOR Q3						**CODES FOR Q7				
RELATIONSHIP TO HEAD OF HOUSEHOLD:										
01 = HEAD		08 = BROTHER/SISTER		01=AT WORK		02=NO SPACE FOR SLEEPING				
02 = SPOUSE		09 = CO-WIFE		03=TRAVELLED						
03 = SON OR DAUGHTER		10 = ADOPTED/FOSTER/STEP-CHILD		04=BOARDING HOUSE						
04 = SON-IN-LAW/DAUGHTER-IN-LAW		11= OTHER RELATIVE (AFFINAL)		06=OTHER (SPECIFY).....						
05 = GRANDCHILD		12= OTHER RELATIVE (CONSANGUINE)		98=DON'T KNOW						
06 = PARENT		13= NOT RELATED								
07 = PARENT-IN-LAW		98=DON'T KNOW								

LINE NO.	EDUCATION (IF AGE 3 OR OLDER & IF ATTENDED SCHOOL)				IF AGE 15 OR OLDER MARITAL STATUS	ETHNICITY	RELIGION
	Has (NAME) ever attended school? NO→16	What is the highest level of education (NAME) attended?*	What is the highest grade (NAME) completed at that level?*	Is (NAME) still in school?	What is the marital status of (NAME)? ***	What is the ethnic group of (NAME)? ****	What is the religion of (NAME)? *****
	(12)	(13)	(14)	(15)	(16)	(17)	(18)
01	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECI	<input type="text"/>
02	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIF	<input type="text"/>
03	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER	<input type="text"/>
04	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
05	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
06	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
07	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
08	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
09	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
10	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
11	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
12	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
13	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
14	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIFY	<input type="text"/>
15	YES NO 1 2	<input type="checkbox"/>	<input type="text"/>	YES NO 1 2	<input type="checkbox"/>	<input type="text"/> 96=OTHER SPECIF.	<input type="text"/>

Just to make sure that I have a complete listing:

- | | | | |
|--|------------------------------|---|----------------------|
| 1) Are there any other persons such as infants or children that we have not listed? | YES <input type="checkbox"/> | → ENTER EACH IN TABLE NO | <input type="text"/> |
| 2) In addition, are there any other people such as domestic servants, lodgers or friends who usually live here? | YES <input type="checkbox"/> | → ENTER EACH IN TABLE NO | <input type="text"/> |
| 3) Are there any guests or temporary visitors staying here, or anyone else who slept here last night that I have not listed? | YES <input type="checkbox"/> | → ENTER EACH IN TABLE NO (SKIP ONE ROW) | <input type="text"/> |
| 4) Are there any persons who used to live in your household but have moved out in the past 1 year? | YES <input type="checkbox"/> | → ENTER EACH IN TABLE NO HOW MANY? | <input type="text"/> |

***CODES FOR Q13**

0=PRE-SCHOOL
1=PRIMARY
2=JHS/MIDDLE
3=SHS/SECONDARY
4=HIGHER
8=DON'T KNOW

****EDUCATION GRADE Q14**

00=LESS THAN 1 YEAR
98=DON'T KNOW

*****CODES FOR Q16**

0=NEVER MARRIED
1= LIVING TOGETHER
2= MARRIED
3= SEPARATED
4=DIVORCED
5= WIDOWED

******CODES FOR Q17**

01=AKAN
02=GA-DANGME
03=EWE
04=GUAN
05=GURMA
06=MOLE-DAGBANI

07=GRUSI
08=MANDE
96=OTHER (SPECIFY)
RECORD ADJACENT TO THE CODE ABOVE.

*******CODES FOR Q18**

01= NO RELIGION
02= CATHOLIC
03= PROTESTANTS
04= PENTECOSTAL/CHARISMATIC
05= OTHER CHRISTIAN
06= ISLAM
07= TRADITIONAL/SPIRITUALIST
08= EASTERN RELIGIONS (ECKANKA , HINDU)
96= OTHER (SPECIFY).....

LINE NO.	FOR VISITORS AND USUAL RESIDENTS	VISITORS ONLY	FOR FORMER RESIDENTS/VISITORS ONLY	OCCUPATION	PopTRCD 2011	
	FOR VISITORS: How long has (NAME) been staying here? ** FOR USUAL RESIDENTS How long has (NAME) lived in this household? ** (USE CODES BELOW) **	Where did (NAME) come from? USE CODES BELOW*	ONLY IF '2' IS CIRCLED IN BOTH COLS. 5 & 6 How long did (NAME) live here before moving out? **	What is (NAME) current occupation? That is what kind of work does (NAME) mainly do?	Was (NAME) a member of this household during the 2011 EDUL (Nov./Dec.) survey? 1=YES → Q28 2=NO 8= DON'T KNOW	
	(19)	(20)	(21)	(22)	(23)	
01	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
02	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
03	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
05	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
06	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
07	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
08	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
09	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
*CODES FOR Q20 1= WITHIN THE SAME COMMUNITY 2= ANOTHER COMMUNITY IN ACCRA 3= ANOTHER TOWN 4= RURAL 5= BOARDING SCHOOL 8=DON'T KNOW		**CODES FOR Q19 AND Q21 1= DAY 2= WEEKS 3=MONTHS 4= YEARS 5=SINCE BIRTH 8=DON'T KNOW		***CODES FOR Q22 01=NO OCCUPATION 02=PROFESSIONAL/TECHNICAL 03=MANAGEMENT 04=CLERICAL 05=SALES 06=AGRICULTURE- SELF EMPLOYED 98=DON'T KNOW		07=AGRICULTURE 08=HOUSEHOLD AND DOMESTIC 09=SERVICE 10=SKILLED MANUAL 11=UNSKILLED MANUAL 12=STUDENT 96=OTHER (SPECIFY).....
	(24)	(25)	(26)	(27)		
	Was there any person(s) who was a member of your household during 2011 PopTRCD (EDULINK) survey but currently not a member now? 1=YES 2=NO → SKIP TO Q28	Please give me the name(s) of that person(s)	What is the reason for [NAME]'s absence?****	Where did [NAME] go to?*****		
	<input type="checkbox"/>	a.				
		b.				
		c.				
		d.				
****CODES FOR Q26 01 = EMPLOYMENT 02 = LOOKING FOR WORK 03 = SCHOOL 04 = VISIT FAMILY 05 = VISIT FRIENDS 06 = MARRIAGE/COHABITATION		07 = PERSONAL REASONS 08 = ESCAPE VIOLENCE OR POLITICAL PROBLEMS 09 = PRISON 10 = HOSPITAL /CLINIC 11 = NURSING HOME/OLD PERSONS HOME 12 = DIED _ go to Next HH member 96= OTHER (SPECIFY).....		****CODES FOR Q27 1 = DIFFERENT HOUSEHOLD IN SAME COMMUNITY/LOCALITY/ NEIGHBOURHOOD 2 = RURAL AREA IN DIFFERENT PART OF THE COUNTRY 3 = CITY/URBAN AREA IN DIFFERENT PART OF THE COUNTRY 4 = ANOTHER COUNTRY 8 = DON'T KNOW		

CHRONIC NON-COMMUNICABLE DISEASE CONDITIONS

LINE NO.	Has (Name) ever been told by a health professional that he/she has had a stroke ? 1. YES 2. NO → Q31 <i>If less than 1 year for Q28b, code 00</i>	Has (Name) been taking any medications or other treatment for it during the last 2 weeks ? 1. YES 2. NO	Has (Name) been taking any medications or other treatment for it during the last 12 months ? 1. YES 2. NO	Has (Name) ever been diagnosed with high blood pressure (hypertension)? (<i>Not including hypertension associated with a pregnancy</i>) 1. YES 2. NO → Q34 <i>If less than 1 year for Q31b, code 00</i>	Has (Name) been taking any medications or other treatment for it during the last 2 weeks ? 1. YES 2. NO (Other treatment might include weight loss program or change in eating habits.)	Has (Name) been taking any medications or other treatment for it during the last 12 months ? 1. YES 2. NO (Other treatment might include weight loss program or change in eating habits.)		
	(28a)	(28b) IF YES, HOW LONG(years)?	(29)	(30)	(31a)	(31b) IF YES, HOW LONG(years)?	(32)	(33)
01	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
02	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
03	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
04	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
05	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
06	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
07	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
08	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
09	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
15	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>

CHRONIC NON-COMMUNICABLE DISEASE CONDITIONS

LINE NO.	Has (Name) ever been diagnosed with diabetes (high blood sugar)? (Not including diabetes associated with a pregnancy) 1. YES 2. NO → Q37 <i>If less than 1 year for Q34b, code 00</i>		Has (Name) been taking insulin or other blood sugar lowering medications during the last 2 weeks? 1. YES 2. NO	Has (Name) been taking insulin or other blood sugar lowering medications during the last 12 months? 1. YES 2. NO	Has (Name) ever been diagnosed with any other chronic non-communicable disease apart from conditions mentioned in (Q28, Q31, and Q34 - Stroke, hypertension and diabetes) 1. YES 2. NO → Q41	If Yes in Q37, please specify: <i>(Interviewer, record all mentioned)*</i> <i>If less than 1 year for Q34b, code 00</i>		Has (Name) been taking any medication or therapy for the condition during the last 2 weeks? 1. YES 2. NO	Has (Name) been taking any medication or therapy for the condition during the last 12 months? 1. YES 2. NO
	(34a)	(34b) IF YES, HOW LONG (years)?	(35)	(36)	(37)	(38a)	(38b) IF YES, HOW LONG (years)?	(39)	(40)
01	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
02	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
03	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
05	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
06	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
07	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
08	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
09	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Code For Q38*
1=ARTHRITIS
2=ANGINA (coronary heart disease)
3=ASTHMA
4=CANCER
5=DEPRESSION
6= OTHER (SPECIFY).....

NO	Question	Response	SKIP
52	How do you mainly store your drinking water? <i>Codes below</i>	<input type="text"/>	IF CODE , 1,3,5,7,8 9 SKIP to 55
53	If container has a lid, does the lid screw on or attach tightly to the container? 1=YES 2=NO	<input type="text"/>	
54	Does the container have a spigot or small mouth or tap for dispensing water? 1=YES 2=NO	<input type="text"/>	
55	Do you do anything to make this water safe to drink? 1=YES 2=NO	<input type="text"/>	IF CODE 2 OR 8, SKIP to 57
56	What do you usually do to make the water safe to drink? <i>Codes below</i>	<input type="text"/>	
57	What kind of toilet facility does your household mainly use? <i>Codes below</i>	<input type="text"/>	IF CODE 1, SKIP to 59
58	Do you share the above mentioned toilet facility with other households? 1=YES 2=NO	<input type="text"/>	
59	Do you have a refuse bin in your household? 1=YES 2=NO	<input type="text"/>	
60	Who usually disposes of the household solid waste? 1=ADULT WOMAN 2=ADULT MAN 3=FEMALE CHILD (UNDER 15 YEARS) 4=MALE CHILD (UNDER 15 YEARS)	<input type="text"/>	
61	Where do you dispose of household solid waste? 01=COLLECTED AT HOME BY A PRIVATE COMPANY 05=TRUCK PUSHERS (KAYA BOLA) 02=COLLECTED AT HOME BY A GOVERNMENT AGENCY 06=INDISCRIMINATELY 03=REFUSE CONTAINER 07=BURNING 04=COMMUNITY DRAIN 08=OTHER (SP.)	<input type="text"/>	
62	Do you pay for disposing of household solid waste? 1=YES 2=NO	<input type="text"/>	IF CODE 2, SKIP to 64
63	How much do you pay monthly?	Amount in GH C <input type="text"/>	
64	How do you dispose household liquid waste (waste water from bathing, preparation of food, cooking and other personal and domestic activities)? 1=SEPTIC TANK 2=COMMUNITY DRAIN 3=BACK OF HOUSE 4=INDISCRIMINATELY 5=OTHER (SPECIFY).....	<input type="text"/>	
65	What is the main source of cooking fuel for this household? <i>codes below</i>	<input type="text"/>	
66	Does your household have.....? 1=YES 2=NO	<input type="text"/>	1=YES 2=NO
	CAR		WASHING MACHINE
	BICYCLE		TELEVISION
	BOAT/CANOE		RADIO
	TRUCK		TELEPHONE/Mobile Phone
	AN OUTBOARD MOTOR		CLOCK
	REFRIGERATOR		ELECTRIC/GAS STOVE
	FREEZER		SOFA
	GENERATOR		SEWING MACHINE
	IRON		ELECTRIC FAN
	COMPUTER		FISHING NET
Codes: Question 52		Codes: Question56	
01=OVERHEAD TANK		01=BOIL	
02=PLASTIC/STEEL CONTAINER WITH LID		02=ADD BLEACH, CHLORINE, OR ALLOY	
03=PLASTIC/STEEL CONTAINER WITHOUT LID		03=STRAIN THROUGH A CLOTH	
04=EARTHEN WARE POT WITH LID		04=SOLAR DISINFECTION	
05=EARTHEN WARE POT WITHOUT LID		05=LET IT STAND TO SETTLE	
06=ALUMINIUM BUCKET WITH LID		06=WATER TABLETS	
07=ALUMINIUM BUCKET WITHOUT LID		07=ALUM	
08=BASIN(PLASTIC/ALUMINIUM/ENAMEL		08=CAMPHOR	
09=SACHET		96=OTHER (SPECIFY).....	
96=OTHER (SPECIFY).....		98= DON'T KNOW	
Codes: Ques.57		Codes: Q65	
01=NO FACILITY		01=NONE/NO COOKING	
(BUSH/BEACH/FIELD)		02= WOOD	
02=WATER CLOSET		03=GAS	
(W.C)/FLUSH TOILET		04=ELECTRICITY	
03= KVIP		05=KEROSENE	
04= PIT LATRINE		06=CHARCOAL	
05=BUCKET/PAN		07=CROP RESIDUE	
06=PUBLIC TOILET		08=SAW DUST	
(W.C,KVIP, PIT		09=ANIMAL WASTE	
LATRINE,BUCKET/PAN)		96=OTHER	
96=OTHER		(SPECIFY).....	
(SPECIFY).....			

67	How many rooms does this household occupy? (count living, dining, bedrooms but not bathrooms ,toilet, kitchen& store room)	<input type="text"/>
68	How many of the rooms are designed primarily for sleeping?	<input type="text"/>
69	How many household members sleep outside the designated sleeping rooms? CODE 00 IF NO HOUSEHOLD MEMBER SLEEPS OUTSIDE	<input type="text"/>
70	Who owns this dwelling? 01=OWNED BY HH MEMBER 05=PRIVATE EMPLOYER 02=BEING PURCHASED (e.g., Mortgage) 06=OTHER PRIVATE AGENCY 03=RELATIVE NOT HH MEMBER 07=PUBLIC/GOVERNMENT OWNERSHIP 04=OTHER PRIVATE INDIVIDUAL 96=OTHER (SPECIFY)_____	<input type="text"/>
71	What is the present holding/tenancy arrangement of this dwelling? 1=OWNING 2=RENTING 3=RENT FREE 4=PERCHING 5=SQUATTING 6=OTHER (SPECIFY)_____	<input type="text"/>
HOUSEHOLD OBSERVATION		
72	What type of dwelling does this household occupy? Record observation 01=SEPARATE HOUSE 05=SEVERAL HUTS/ BUILDING 09= ATTACHED TO SHOP 02=SEMI-DETACHED HOUSE 06=TENT 10= COMPOUND HOUSE 03=FLAT/APARTMENT 07=KIOSK 96=OTHER (SPECIFY)_____ 04=ROOMS 08=CONTAINER	<input type="text"/>
73	What is the main material of the floor? Record observation 01=EARTH/SAND 05=WOOD PLANKS 09=CERAMIC TILES/PORCELAIN 02=BURNT BRICKS 06=TERRAZO 10=VINYL TILES 03=CEMENT/CONCRETE GRANITE/MARBLE 07=WOOLEN CARPET 11=STONE 04=WOOD 08=LINOLEUM/RUBBER CARPET	<input type="text"/>
74	What is the main material of the roof? Record observation 01=THATCH/PALM LEAF/SOD 06=ROOFING SHINGLES 02=RUSTIC MAT 07=ASBESTOS/SLATE ROOFING SHEETS 03=CARDBOARD 08=PALM/BAMBOO 04=METAL SHEETS 09=WOOD 136 05=BRICK TILES 10=CEMENT 96=OTHER (SPECIFY).....	<input type="text"/>
75	What is the main material of the wall? RECORD OBSERVATION 01=CANE/PALM/TRUNKS 08=MUD BRICKS 02=BAMBOO WITH MUD 09=STONE WITH MUD 03= WOOD 10= PLYWOOD 04=CARDBOARD 11=BAMBOO 05=LANDCRETE 12=CEMENT BLOCKS/CONCRETE 06=BURNT BRICKS 07=METAL SHEETS/SLATE/ASBESTOS 96=OTHER (SPECIFY).....	<input type="text"/>
76	INCOME EVALUATION QUESTION (IEQ) Taking into account your own situation with respect to the physical characteristics of your family and job you would call your net-income (including gifts from family and friends, and tips) per year	
		GHANA CEDIS
	MORE THAN WHAT YOU NEED (IF IT WERE ABOVE)	
	JUST WHAT YOU NEED (IF IT WERE BETWEEN)	
	BARELY WHAT YOU NEED (IF IT WERE BETWEEN)	
	LESS THAN WHAT YOU NEED (IF IT WERE BETWEEN)	
	MUCH LESS THAN WHAT YOU NEED (IF IT WERE BELOW)	
77	Who is the primary source of income for this household? 01=HEAD OF HOUSEHOLD 04= A DIFFERENT MEMBER OF THE HOUSEHOLD 02=PARTNER/SPOUSE 96=OTHER (SPECIFY)..... 03=BOTH SHARED EQUALLY (HEAD AND SPOUSE)	<input type="text"/>
78	How much can you rely on relatives outside of your household or friends for financial support if you need it? 1=A LOT 2=SOMETIMES 3=A LITTLE 4=NOT AT ALL	<input type="text"/>

NO	Question	RESPONSE		
		YES	NO	
79	Who manages sanitation resources in your community? Prove: Circle all that apply	a. AMA/SUB-METRO	1	2
		b. UNIT COMMITTEE	1	2
		c. LOCAL WATER/SANITATION COMMITTEE	1	2
		d. COMMUNITY DEVELOPMENT COMMITTEE	1	2
		e. NGO	1	2
		f. TRADITIONAL LEADER(S)	1	2
		g. RELIGIOUS ORGANISATION(S)	1	2
		h. PRIVATE INDIVIDUAL(S)	1	2
		i. PRIVATE ORGANISATION	1	2
		j. OTHER.....	1	2
		k. DON'T KNOW	1	2
80	What are the major environmental challenges that you face in this community	a. FLOODING	1	2
		b. POOR SANITATION	1	2
		c. POLLUTION	1	2
		d. HIGH TEMPERATURE (HEAT)	1	2
		e. SEA LEVEL RISE	1	2
		f. OTHER (SPECIFY).....	1	2
IF NO TO ALL, SKIP TO Q84				
81	Which is the most challenging environmental issue mentioned in Ques.80 above? Specify _____	<input type="checkbox"/>		
82	What are the most common diseases in this community that are associated with these environmental challenges?	a. DIARRHOEA	1	2
		b. MALARIA	1	2
		c. CEREBRO-SPINAL MENINGITIS	1	2
		d. SKIN RASH	1	2
		e. COUGH/DIPHTHERIA	1	2
		f. OTHER (SPECIFY).....	1	2
1				
83	What is the most common disease mentioned in Ques.82 in this community that is associated with environmental challenges? Specify _____	<input type="checkbox"/>		
84	What is the distance from your house to the nearest standing water or open gutter? <i>Distance in meter</i>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>		
85	When was the last time you or any member of your household had diarrhoea? 1=LESS THAN A WEEK AGO 2=A WEEK AGO 3=TWO WEEKS AGO 4=THREE WEEKS AGO 5=A MONTH AGO 6=MORE THAN A MONTH AGO 7=NEVER HAD DIARRHOEA	<input type="checkbox"/>		
IF CODE 7, SKIP TO Q90				
86	How many times did you or any member of your household have diarrhoea within the past month?	<input type="text"/> <input type="text"/>		
87	Did you or the member of your household seek advice or treatment for the diarrhoea (from any source)? 1=YES 2=NO	<input type="checkbox"/>		
If code 2 SKIP to Q.90				
88	Where did you first seek advice or treatment for the diarrhoea? 01=HOSPITAL/CLINIC 03= HERBAL MEDICINE (SELF PRESCRIPTION) 05=(SELF PRESCRIPTION) 02=PHARMACY/DRUG STORE 04=HERBAL MEDICINE 96=OTHER (SPECIFY).....	<input type="text"/> <input type="text"/>		
89	How many days after the diarrhoea began did you first seek advice or treatment?	<input type="text"/> <input type="text"/>		
90	The last time the youngest child (under 5 years) passed stool, what was done to dispose of the stool? CHECK HH ROSTER IF THERE IS A CHILD UNDER 5 YEARS 01=CHILD USED TOILET/LATRINE 06=LEFT IN THE OPEN 02=PUT/RINSED INTO TOILET OR LATRINE 07=NO CHILD UNDER 5 YEARS 03=PUT/RINSED INTO DRAIN OR DITCH 96=OTHER (SPECIFY)..... 04=THROWN INTO GARBAGE 98=DON'T KNOW 05=BURIED	<input type="text"/> <input type="text"/>		
		<input type="text"/> <input type="text"/>		
		<input type="text"/> <input type="text"/>		
		<input type="text"/> <input type="text"/>		
		<input type="text"/> <input type="text"/>		
		<input type="text"/> <input type="text"/>		

Household level conditions and adaptive capacity			
91	Have you noticed any change in climate (Rainfall and Temperature) for past 30 years? 1=YES 2= NO 8=DON'T KNOW	<input type="checkbox"/>	IF CODE 2 or 8, SKIP TO Q99
92	What changes have you noticed? <i>(circle all that apply)</i>		
		YES	NO
	a. Getting more rainfall than before	1	2
	b. Less rainfall than before	1	2
	c. Rainfall becoming erratic/unpredictable	1	2
	d. Increase in temperature	1	2
	e. Decrease in temperature	1	2
	f. Other (specify).....	1	2
93	How sure are you that the pattern of rainfall and temperature are changing? 1=Extremely sure 2=Sure 3=Somewhat sure 4=Not at all sure	<input type="checkbox"/>	
94	How worried are you about the changing pattern of rainfall and temperature? 1=Very worried 2=Somewhat worried 3=Not worried 4=Not at all worried	<input type="checkbox"/>	
95	What in your opinion causes these changes in rainfall and temperature? <i>(circle all that apply)</i>		
		YES	NO
	a. Emissions from cars and trucks	1	2
	b. Burning fuel for heat and electricity	1	2
	c. Deforestation	1	2
	d. Toxic wastes	1	2
	e. Aerosol spray cans	1	2
	f. Volcanic eruptions	1	2
	g. Cow rearing	1	2
	h. Other (specify)	1	2
96	Which of the above mentioned factors contribute most to changes in rainfall and temperature? 1=Emissions from cars and trucks 4=Toxic wastes 7=Cow rearing 2=Burning fuel for heat and electricity 5=Aerosol spray cans 8= Other (specify) 3=Deforestation 6=Volcanic eruptions	<input type="checkbox"/>	
97	In your opinion, what is the effect of changing pattern of rainfall and temperature on the one's chances of getting malaria? 1=It promotes the breeding of mosquitoes 2=It increases one's chances of getting malaria 3=It does not affect incidence of malaria 4=Other, specify.....	<input type="checkbox"/>	
98	In your opinion, what is the main course of action that can be taken to reduce the effect of changing pattern of rainfall and temperature on the incidence of malaria? 1=Use of mosquito net 2=Use mosquito coil/repellent 3=Clean our environment 4=Desilting clogged gutters 5=Other, specify	<input type="checkbox"/>	
99	Indicate which of the following reflects your household's capacity to prevent and treat malaria 1=My household has adequate capacity to prevent the incidence of malaria 2=My household has inadequate capacity to prevent the incidence of malaria 3=My household has adequate capacity to treat malaria 4= My household has inadequate capacity to treat malaria 5=My household has inadequate capacity to prevent and treat malaria 6= My household has adequate capacity to prevent and treat malaria	<input type="checkbox"/>	

100	The last time you or any member of your household was diagnosed of malaria, were you made to undergo a laboratory test for confirmation 1 = YES 2 = NO	<input type="checkbox"/>
101	If household members do not seek treatment from health facility, what reason do they have for not seeking treatment from health facility 1= I believe the herbs are effective 2= Lack of money 3= Delays/long queue in the hospital 4= Treatment in the facility not effective 5= Household sought treatment 6= Other (specify).....	<input type="checkbox"/>
102	Considering your household's condition as well as the prevailing conditions in your community, how would you rate your household risk or vulnerability to the incidence of malaria on a scale of 0-3? 0=No Risk 1=Small 2=Moderate 3=Great	<input type="checkbox"/>
103	During the last rainy season (May to July) did your community experience any flooding? 1 = YES 2 = NO	<input type="checkbox"/>
		IF CODE 2 SKIP TO Q108
104	How many times did you experience it within the season?	<input type="text"/> <input type="text"/>
105	If flooding occurred in your community during the last season, how many days did it take for the area to completely dry up?	<input type="text"/> <input type="text"/>
106	If flooding occurred in your community during the last season, how would you rate it: 1= MILD 2= MODERATE 3=SEVERE	<input type="checkbox"/>
107	How often is your house affected by flooding in a year? 1=Once a year 2=Two or more times a year 3=Not affected at all	<input type="checkbox"/>
108	What in your opinion causes malaria? (<i>tick those mentioned</i>)	
	1. Bites from infected mosquitoes	<input type="checkbox"/>
	2. Dirty environment	<input type="checkbox"/>
	3. Too much exposure to sunlight	<input type="checkbox"/>
	4. Eating oil rice	<input type="checkbox"/>
	5. Bites from mosquitoes	<input type="checkbox"/>
	6. Other (specify)	<input type="checkbox"/>
109	On the average how much do you spend on the treatment of each episode of malaria?	Amount in GHC <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
110	The last time you or any member of your household was sick of malaria, how much did you or the person spend on malaria medication ?	Amount in GHC <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
111	Are the windows in the house covered with mosquito-proof screens/net? 1 = YES 2 = NO	<input type="checkbox"/>
112	On average, how much does your household spend on the following each month? 1=MOSQUITO COILS 2=MOSQUITO SPRAY 3=MOSQUITO REPELLING CREAM 4=NO AMOUNT SPENT	Amount in GHC <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
113	What is the total amount of money you and the members of your household spend on health related issues each month, on the average?	Amount in GHC <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

114	How often do you receive health related information or assistance in this community? (from any source) 1=At least once a year 2=More than once a year 3=Not at all	<input type="checkbox"/>	IF CODE 3 SKIP TO Q116		
115	What is the main source of the information? 1=TV 5=MOSQUES/CHURCHES 9=WORK PLACE 2=RADIO 6=SCHOOLS/TEACHES 10=DRAMA /PERFORMANCE 3=NEWSPAPER 7=COMMUNITY MEETING 11=OTHER (SPECIFY _____ 4=PAMPLETS/POSTERS 8=FRIENDS/ RELATIVES	<input type="checkbox"/>			
	Is there any institution you turn to for help when you have health related problems in this community? <i>(Tick all that apply)</i> IF NONE, SKIP TO Q121	Mention the kind of support received. <i>Codes below*</i>	Specify amount in monetary terms or specify type of kind	Have you received any support from organisation in the past one year? 1=Yes 2=No	How would you rate the support received? <i>Codes below**</i>
	(116)	(117)	(118)	(119)	(120)
	Community based organization				
	Private organization				
	Government agency				
	Other(specify)				
Codes for Q117*		CodesQ120**			
1=Monetary		1=Able to meet all the need of household at the time			
2=In kind		2=Somewhat able to meet the need of household?			
3=Moral/psychological		3=Not helpful at all			
HOUSEHOLD AND FAMILY SUPPORT NETWORKS AND TRANSFERS					
The next questions are about your family and friends, specifically those not living with you in this household. Families and friends sometimes help one another in a variety of ways, and each type of help or support can be important. Part of our survey involves finding out how they do that. We would now like to ask some questions about your family and friends who do not live with you, and the different ways in which you help or support each other. The next questions are about help received by your household in the last 12 months.					
121	Has any member of the household received any financial credit/loan within the past one year? 1 = YES 2 = NO	<input type="checkbox"/>			
122	In the last 12 months, has anyone in the household received any financial or in-kind support from your family (children, siblings or parents), relatives (other kin) and friends who do not live with you? 1=YES 2=NO 8=DON'T KNOW	<input type="checkbox"/>	IF CODE 2 OR 8 SKIP TO Q126		
123	What type of assistance did your household receive? 1=MONEY ONLY 2=KIND ONLY (Specify)..... 3=BOTH MONEY AND KIND (specify).....	<input type="checkbox"/>			
124.	What are the purposes of the support? <i>(Tick all that apply)</i> a. General and household upkeep b. Education c. Medical care d. Business and work related e. Social events f. Other (specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

125.	About how much would this assistance amount to over the last 12 months in Ghana Cedi (GH¢) <i>(if in kind impute and estimate the value)</i>	GH¢	0	0	0	0	0	0	0	
126.	In the last 12 months, has your household provided any financial aid or in-kind support to any of your children, grandchildren and/or other family (and those of your spouse) who do not live in this household? 01=YES 02=NO 8=DON'T KNOW		<input type="checkbox"/>	IF CODE 2 OR 8 SKIP TO Q130						
127.	What type of assistance did your household provide? 1=MONEY ONLY 3=BOTH MONEY AND KIND 2=KIND ONLY (Specify).....		<input type="checkbox"/>							
128.	What are the purposes of the support provide? <i>(Tick all that apply)</i> a. General and household upkeep b. Education c. Medical care d. Business and work related e. Social events f. Other			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
129.	Can you give an approximate total amount for this for the last 12 months in Ghana Cedis (GH¢) <i>(if in kind impute and estimate the value)</i>	GH¢	0	0	0	0	0	0	0	
130.	During the past year, did you or someone in your household provide help to a relative or friend (adult or child), because this person has a long-term physical, or mental illness, or disability, or is getting old and weak? 1=YES, physical illness 4= YES, GETTING OLD AND WEAK 2=YES, mental illness 5=NO 3= YES, DISABILITY		<input type="checkbox"/>							

FOOD SITUATION AND EXPENDITURE

131.	Was there a day in the previous 30 days when you or any member of the household did not have enough food to eat? 0=No 1=Between 1-5 days 2=Between 6-10 days 3=More than 10 days	<input type="checkbox"/>																																
132.	Please indicate whether your household bought cooked food (breakfast, lunch and dinner) from street vendors for each of the days within the past week. <i>(Tick all that apply)</i>																																	
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134	How do you perceive your household vulnerability to increase rainfall/flood? 1=low 2=Medium 3=High 4=Very High	<input type="checkbox"/>		
135	Do you do anything to cope with the floods? 1=YES 2=NO	<input type="checkbox"/>		
136	If Yes to Que. what do you do?			
				Y
		Borrowed money		
		Relocate		
		Rely on Social groups		
		Clear drains		
		Changed income generation Activity		
		Other sp_____		

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